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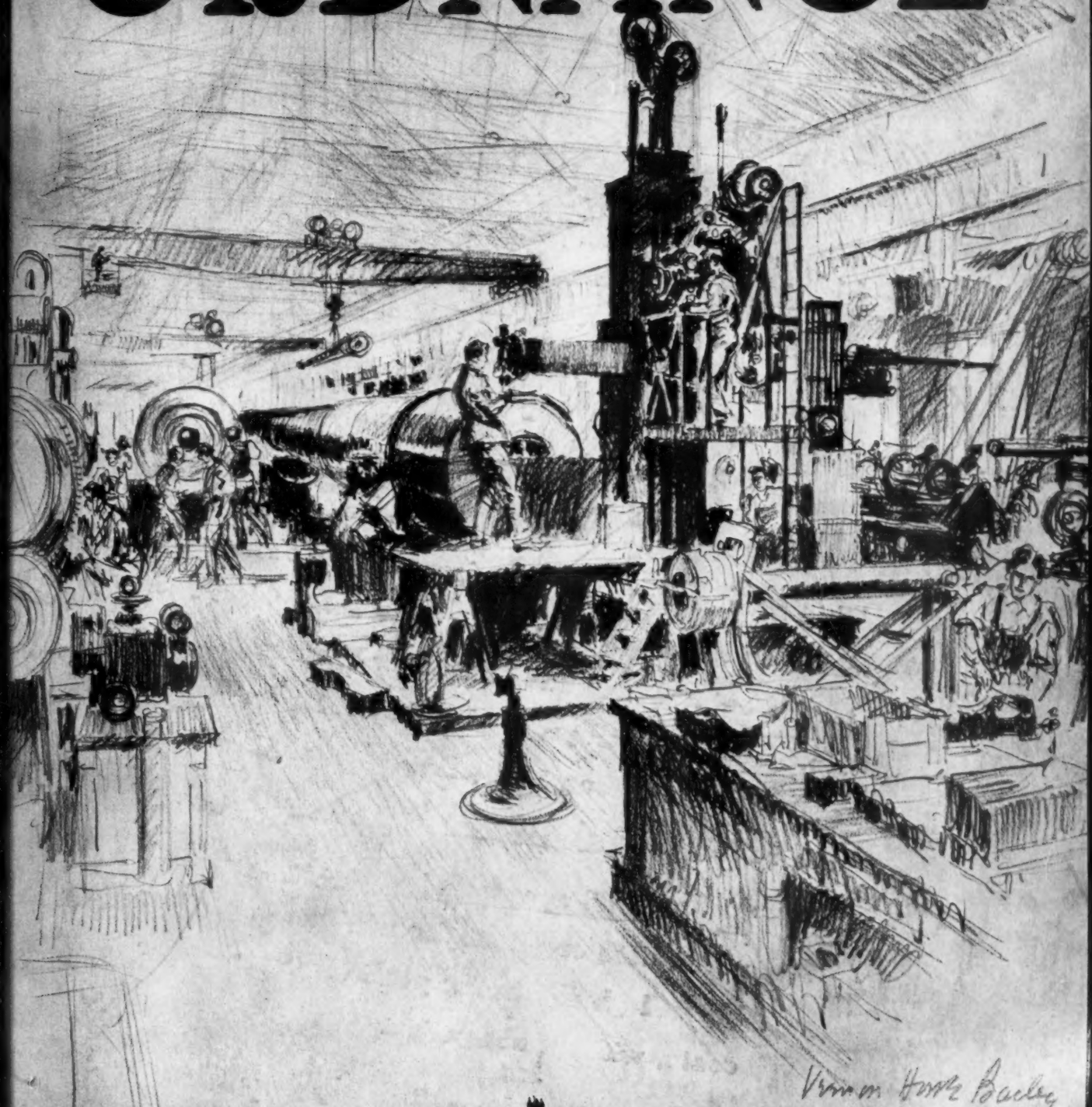
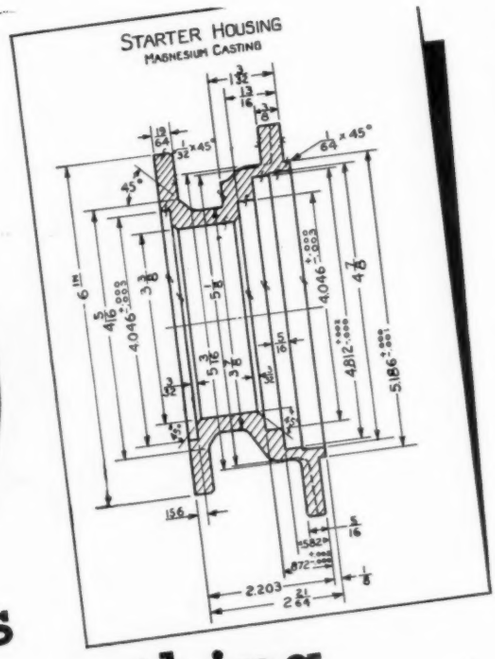


Vernon Howe Bailey

AOA

THE JOURNAL OF THE ARMY ORDNANCE ASSOCIATION



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ARMY ORDNANCE

The Journal of the Army Ordnance Association

Pledged to Public Service in Effecting Industrial Preparedness for War as Our Strongest Guarantee of Peace

Published by the Army Ordnance Association, Suite 805, The Mills Building, Washington, D. C. Editor: L. A. Codd.
Authors alone are responsible for statements made and opinions expressed in their respective articles. Specially written articles on appropriate subjects are solicited.

Issued Bimonthly. Single Copy 75c.
Subscription rate: Continental U. S. $4.50 per annum, foreign $5.00, in advance. Entered as second-class matter August 14, 1920, at the Post Office at Washington, D. C., under the Act of March 3, 1879. Additional second class entry at the Post Office at Richmond, Va.

Volume XII | NOVEMBER-DECEMBER, 1931 | No. 69

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"The industrial war plan must conform to the living body of industry—to its customs, practices, organization and character. No human mind can grasp every detail. It can only be developed by years of labor and research. Occupying the space between the continuously changing body of industry and the intermittently changing war plan, it must slowly shape itself to each."

—Patrick J. Hurley, Secretary of War.

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The objectives of the Association as set forth in its Constitution are:

To assist in effecting industrial preparedness for war as being one of the nation's strongest guarantees of peace;

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To promote mutual understanding and to effect cooperation with American scientists, inventors, engineers and manufacturers in civil life and the regular and reserve officers of the Ordnance Department.

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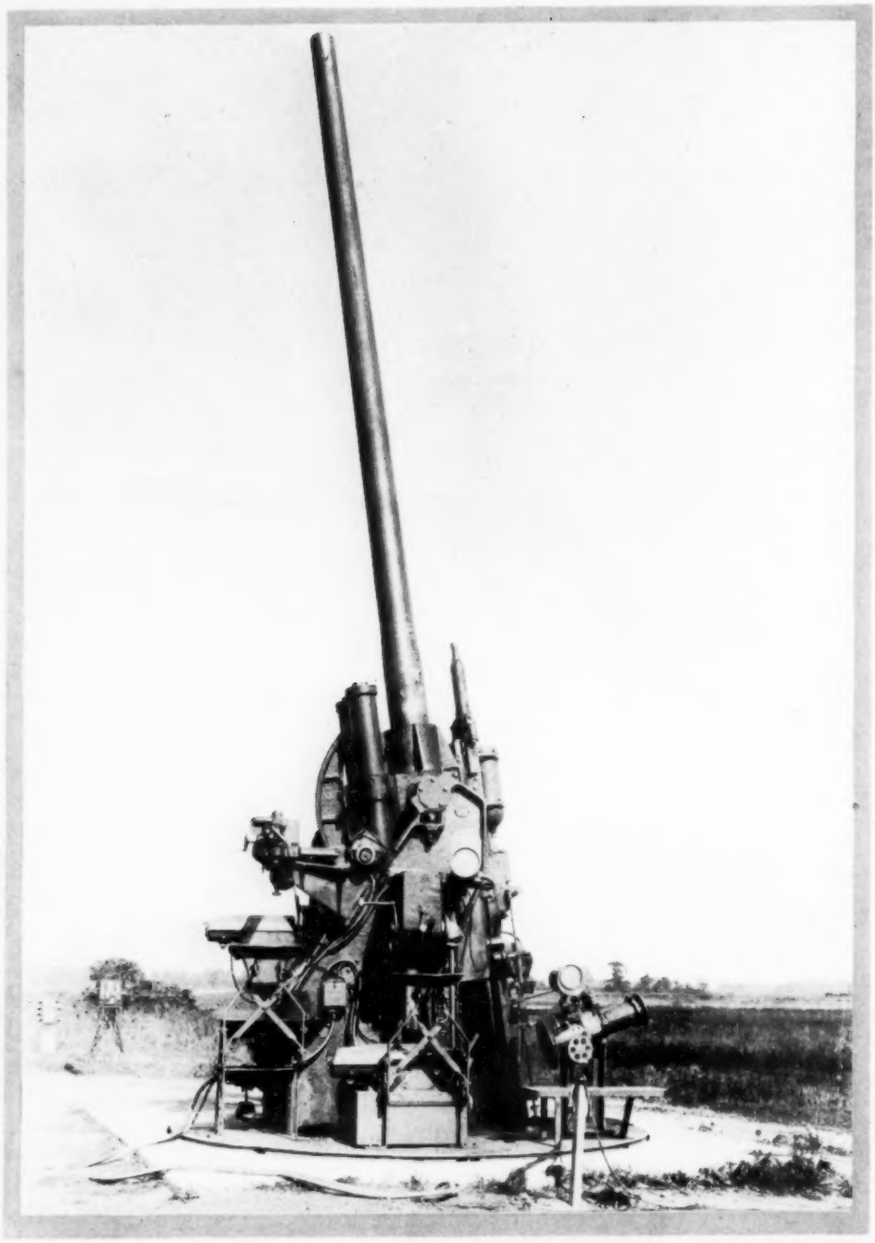

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ARMY ORDNANCE

VOL XII NOVEMBER-DECEMBER, 1931 No. 69

Tactics and Matériel

Part I: The Characteristics of a Modern Major War

By General M. J. Challéat

OUR eminent ballistician, General Charbonnier of the Naval Artillery, invited me on behalf of ARMY ORDNANCE to prepare an article* for our American friends giving my personal views on the influence that the recent progress in modern war matériel must exercise on the tactics and strategy of the future. I accepted this undertaking with the greatest pleasure as I was very happy to collaborate with a publication whose value I have frequently had the opportunity of appreciating. Moreover, in discussing the steps taken by my country for its security, evidence is once more provided of the peaceful sentiments of the French people, who seek only the opportunity of living tranquilly within their borders. France does not desire to invade any country. What she does not want is to be surprised again by an invasion and to suffer the same calamities, too cruel and too recent to have yet been forgotten. Moreover, I am very happy to discuss new developments for readers who are inclined to seek information concerning progress in all fields of endeavor, as has been proved frequently.

General Challéat
General de Division (Cadre Reserve)
of the French Artillery

I shall consequently discuss the subjects enumerated hereafter, taking into consideration, the most recent progress in matériel of all kinds: 1. The Characteristics of a Modern Major War. 2. Modern Methods of Waging War. (The break-through, defensive on the ground and offensive in the air, sudden attack with a view to carrying the war into hostile territory prior to the existence of a continuous and solidly occupied front, defensive on the ground and in the air). 3. The Corresponding Organizations (regular army with volunteers and *levée en masse,* nations in arms, with covering forces and systems of defense). These are the headings under which this study will be made.

THE war of 1914-1918 emphasized the power of fire in general, and more particularly the power of flanking fire of automatic weapons from the point of view of the defensive. If to this important observation is added the one of no less importance of the value of barbed wire entanglements as obstacles, when they are well flanked by fire, including the fire of antitank weapons, the actual possibility is readily explained of holding very extended organized fronts with relatively few effectives during a time sufficient to bring up reserves. These reserves can be moved very rapidly in automobiles and consequently are able to arrive at the time and place needed. Therefore, in wars of the future, between large armies, the front of the belligerents can be expected to extend until each flank comes to rest on areas inaccessible to the land forces; for instance, the sea or a neutral capable of making himself respected by unscrupulous adversaries, etc. This was the case (but unfortunately in French territory) in 1914 shortly after Joffre's victory on the Marne. The same condition may arise at the beginning of hostilities if the army on the defensive has taken steps to organize, in time of peace, sufficient covering force on its very frontiers. This covering force would have been furnished a defensive system of permanent fortifications formed of suitable elements suitably located.

Against such fronts, judging by various articles appearing everywhere, the idea is still current that, in order to defeat the enemy, the method of the well known "break through," which was so frequently tried during the war of 1914-1918, should be used. This method consists first of all of assembling with the greatest secrecy in a selected zone of the front considerable resources in personnel, matériel and munitions. The area was selected so that a tactical success might be followed immediately by a strategic success. The attack would begin only after a powerful artillery preparation. Towards the end of the war, thanks to the utilization of tanks, it was occasionally possible to reduce to a great extent and even to eliminate entirely, the artillery preparation preceding to a greater or less degree H hour designated for the attack. Nevertheless the attempts to break through the front were never successfully carried out by any belligerent. By that is meant that they only resulted in a long war of attrition, terminated after more than four years of fighting by the victory of the Allies.

It is consequently time to consider, in the hypothesis of a future war, whether or not it is desirable to persist in the methods previously followed. Shall we use once more the

*This article, prepared especially for ARMY ORDNANCE by General Challéat, is translated from the French by Maj. Donald Armstrong, Ordnance Department, U. S. Army.

devices and methods considered desirable in 1918, even if they are today capable of notable improvement? On the other hand, would it not be possible to find a more rapid and less costly method of carrying on a major war? This question arises, in my opinion, to a greater degree today since certain writers anticipate the "break through" even without tanks, while others place all their faith in absolutely new methods purely the product of their imaginations.

Nevertheless, the former should not lose sight of the fact that, in the first weeks of the war, ammunition consumption will greatly exceed the supply at the front. This is the case either because the larger part of the available transportation is being used for the concentration on the frontiers of troops mobilized in the interior or on account of the limitation of war reserves, and of the delay inherent in the mass production of munitions. They should also take into consideration the fact that even with unlimited ammunition the gun is a mediocre means of destroying barbed wire entanglements, especially when these entanglements are skillfully located. This is true from the triple points of view of the time necessary to secure a breach in the entanglements, of the tonnage of ammunition expended for this purpose, and of the cost of the operation. However, I shall consider these points further on. It is sufficient at present to note that this tonnage for the sole purpose of opening lanes through the entanglements is very large. (And the preparation of the attack requires many other types of firing.)

Moreover the preliminary operations and the necessarily rather long preparation in bringing up the ammunition supply and then firing it arouse the attention of the enemy. Put on the alert in this way, he rapidly brings up his reserves to the second and third line positions where progress of the attack is stopped. Before attacking these new positions the troops on the offensive are consequently obliged to wait rather a long time, not only to reorganize its personnel and matériel, but especially to allow the manufacturing plants the time to produce the necessary supplies of ammunition. In this way we reach a war of attrition analagous to that of 1914-1918.

Consequently the problem that must be studied is as follows: *Should one persist in attempting a "break through" by using matériel better designed than in 1918 in order to avoid a long war of attrition or should a still more rapid solution be sought by other means, and is it possible to hope for success in this way?* That is what I shall discuss now.

TO evaluate the method of the "break through," the following factors must be taken into consideration: (1) Fire power. (2) Liaison between the infantry and the artillery in the attack. (3) Possible improvements in these two domains. (4) The consequences of these improvements on the value of the method of the "break through."

Fire power is needed either to stop the advance of an enemy or to destroy the obstacles and the weapons that the forces on the defensive can oppose to an advance or at least to neutralize these latter obstacles. In other words, the attacker must seek offensive fire power and the defense defensive fire power. These two kinds of fire power are generally encountered simultaneously in the same weapon, but more often one or the other predominates. A particular light machine gun, for instance, which provides essentially defensive fire power could not be considered as completely lacking in offensive power, although its extremely flat trajectory makes almost negligible its material effectiveness against an intrenched enemy. Consequently the fitness of a particular weapon for fire power must generally be considered from both points of view. For convenience, however, I shall examine separately the fitness of the different weapons to furnish one or the other of the two kinds of fire power noted above. It will thus be possible to determine the qualities to be required of a total armament according to the tactics that are to be adopted, in general, in a particular theater of operations. In fact the armament must be determined by the kind of fire power desired. This depends on whether or not in this particular theater of operation it is proposed *more generally* to win ground or on the other hand simply to defend it. I say "more generally" for even in the case where it is desired to advance, the principle of the economy of forces may impose, at least momentarily, the defensive in certain areas of the front. I shall examine consequently, in what follows the fitness of the different kinds of weapons actually in service everywhere to furnish more especially either defensive or offensive fire power, and from that I shall deduce the requirements necessary for an armament designed to accomplish the break through.

DEFENSIVE FIRE POWER OF VARIOUS WEAPONS. Defensive fire power is normally designed to stop the hostile attack. Theory, as will be seen later, and the experience of the war clearly confirms this view, suffices to prove that the light or heavy machine gun, with a very flat trajectory and very rapid fire, is by far the most effective weapon to stop the advancing unprotected infantry at close range, especially when flanking fire is used. Similarly, in order to stop a tank at a range of from 1000 to 1500 meters a very flat trajectory gun firing as rapidly as possible is needed. In fact, curved fire, when direct hits are required, has only a very limited stopping power, no matter what the type of weapon which executes it, on account of the small danger space of the trajectory. Moreover, against certain types of targets the low remaining velocity in curved fire results in ineffective fire. It is, however, the only method possible to secure hits behind cover where the crests are not occupied.

It is important to define these various points. To this end I shall discuss or recall the following ideas:

In order to evaluate the fire power of a weapon, I shall consider its stopping power, defined independently of the courage of the assailant. By this is meant, on the one hand the absolute stopping power defined as the material impossibility for anyone, even a robot, to continue to advance in spite of the fire. If on the other hand this result cannot be obtained, the stopping power might be defined as the more or less complete fashion in which the barrage zone can be effectively covered at short intervals of time. Finally, I shall maintain that it is materially impossible to advance across a barrage line where the enemy is exposed to an effective machine gun bullet every eighth of a second. This requires firing 480 rounds per minute which is possible with the practical rate of fire for the majority of machine guns in service in the various countries.*

*In order to simplify terminology, I shall most frequently speak of a single machine gun, with the understanding that, in practice, in order to sustain such a rate of fire continuously during a fairly long time, five or ten minutes for instance, four machine guns firing successively would be necessary.

DEFENSIVE fire power of a machine gun. Against an enemy advancing towards it (frontal fire), a machine gun firing at the rate indicated would not be certain to stop the attack if the danger space were very small, but deep enough to prevent crossing in less than ⅛ of a second, except for the width of the man advancing in its plane of fire. Consequently a prohibitive number of machine guns would be required to stop the advance on a front of appreciable proportions. But, on account of the great flatness of its trajectory in firing up to 600 meters (if up to that point the terrain does not slope or, if it does, up to the point where the slope changes), a machine gun with its 480 rounds per minute can in practice stop the enemy by a sweeping fire on a front of 60 meters. This requires one shot every fifteen seconds per half meter of front, which is the equivalent of the breadth of a man viewed from the front. Under these conditions even if the enemy advances by rushes, he runs the greatest chance of being hit before he has covered the 600 meters of the danger space, the fifteen-second intervals being in practice too irregular to allow him to take them into consideration. If frontal fire of the machine gun, however, is effective in stopping the attack only on the 60 meters swept, it can, by firing from the flank, stop the attack with theoretical certainty for a distance of 600 meters. Beyond 600 meters the danger space of the bullets decreases progressively as the range increases and the area in which the advance will be stopped decreases progressively. At a range of 800 meters, it is reduced to 100 meters and to be certain to stop an advance, firing without sweeping which gives a dispersion of ten mils in direction must be used. At 800 meters the machine gun consequently covers no more than a front of 8 meters which is very little.

Moreover both for frontal and flank barrage fire the terrain does not always give continuous slopes for 600 meters which would make it possible to utilize the entire absolute arresting power of machine guns. *In short, in firing at ranges of 600 meters the machine gun is able to arrest the enemy's advance, absolutely or almost so, if the terrain permits it, on a front of 60 meters in frontal fire or for 600 meters in flanking fire.* If the machine gun can not stop the man advancing erect beyond 600 meters that does not mean, however, that it has not a very appreciable fire power at much longer ranges as will be shown further on.

Defensive fire power of the light field gun. Firing against tanks must be distinguished from firing against troops advancing without cover. Therefore, let us first consider the defensive fire power of the light field gun as an antitank weapon.

In order to stop a tank a direct hit is necessary with a high explosive shell capable of penetrating the armor protecting its vital parts. In my opinion, it is an illusion to count on a lucky fragment which might damage its machinery or which, for instance, might jam the movement of its tracks, gratuitously assumed to be unprotected. The problem of field artillery fire against tanks is consequently analagous to that of the machine gun firing at troops in the open. The difference in the rate of fire should be noted, however, as the machine gun fires at least 20 times more rapidly than the gun. In consequence of this lower rate of fire, the gun, even when used on the flank, can not oppose an absolute barrier to the advancing tank. Methodical fire must be used in the effort to stop it. Moreover, both to penetrate the armor and to obtain a direct hit on a moving target such as a tank, perforating shell, fired at short range, with a very flat trajectory and high muzzle velocity are required. This practical requirement of firing at short range necessitates the use of single guns, well hidden in advanced positions, and which must not come into action except to fill their especial mission of antitank weapons.

As to the defensive fire power of a 75-mm gun, for example, on troops advancing without cover. In this case, not direct hits on the target, but the area effectively covered by the shrapnel balls or by the shell fragments must be studied.

a. *High explosive shell.* The fragments of a high explosive shell divide into three general groups:

The side spray, containing many fragments and more or less open, formed of irregular splinters (smaller with the semi-steel than with the steel shell), the trace of which on the ground is called the "chop."

A base spray, containing often only a few large fragments;

A nose spray, containing, in general, only a few fragments.

Within a radius of about ten meters from the point of burst of a light artillery projectile weighing from five to seven kilograms, semi-steel shell are more effective than the steel on account of the greater number of fragments. Beyond about 10 meters, steel shell are on the contrary considerably more effective than the semi-steel shell whose small fragments quickly lose their velocity. The steel shell are appreciably effective up to even about 20 meters from the point of burst.

The burst may take place above the ground on the trajectory (time fuze) or above the ground after ricochet (percussion fuze with short delay), or on the surface of the ground (percussion fuze of the instantaneous type). In the first case, with a good height of burst (about 10 meters) the "chop" covers an effective area perpendicular to the plane of fire 15 meters wide and 5 meters in depth. In ricochet fire (maximum angle of fall 10 degrees) the ricochet occurs in various directions relative to the plane of fire due to the lack of homogeneity of the ground and the burst takes place in the air at a height varying from 2 to 6 meters. The "chop" oriented in different directions may consequently be wider than 15 meters but it will be considerably less than five meters in depth. Finally, in bursts on the surface the "chop" perpendicular to the plane of fire may be about 30 meters wide and .30-meter in depth.

From these data it results that:

On the one hand, *in order to establish a barrage line by means of light artillery high explosive shell using frontal fire, the most advantageous method of fire is percussion fire with instantaneous fuze.*

On the other hand, *on account of the orientation of the "chop," fire from the flanks from the point of view considered is not more advantageous than frontal fire.*

b. *Shrapnel.* This type of projectile bursting at a suitable height, i. e., not exceeding two or three mils as seen from the gun, has an effective zone about 20 meters wide and 150 meters in depth against troops advancing without cover, or approximately one third of a hectar (hectar=10,000 sq. meters).

It is now easy to evaluate the defensive fire power of the light artillery gun based on the kind of projectile used, weighing from five to seven kilograms. Let us assume a four gun battery whose mission is to obtain a barrage line

100 meters wide at a range of 3000 meters by firing four high explosive shells per gun per minute. This rate of fire should not be exceeded if the firing lasts for a long time using the maximum charge, as a higher rate of fire erodes the matériel too rapidly. To simplify the discussion, I shall assume that the four guns fire regularly and simultaneously. It is evident that if the simultaneous four rounds from the battery absolutely arrest the attack, this would happen only every fifteen seconds. But firing such as this of an intermittent character does not absolutely stop the advance, for on account of the range dispersion the four rounds do not burst on the same line. As a matter of fact they are scattered over a depth of about 100 meters and the area subjected to fire is consequently one hectar. Therefore, in conformity with what has been said previously, the portion of the zone effectively covered in this way every fifteen seconds must be evaluated. Shell fired with instantaneous fuze has a "chop" of about 1/1000th of a hectar, i. e., about 1/1000th of the area to be covered. (.30m times 30m equals 10 square meters approximately.) Consequently, this area is covered effectively each minute only on a little less than 16/1000ths of its total surface. Undoubtedly, in reality the sixteen rounds considered would not be distributed uniformly on the assumed depth of 100 meters, and most frequently an area about one-half this depth will contain nearly all the rounds. Even in the most favorable case, however, this fraction cannot exceed 32/1000ths.

Although these figures do not take into consideration the head and base sprays, nor ascending sprays, they explain how certain barrage lines could be crossed by experienced troops with losses much less than those which might have been anticipated. They explain also why it could be said *that stopping fire* (American artillery equivalent is "standing barrage") *of the light artillery did not stop an advance any more than another type of firing made an effective barrage because it was called barrage fire.* The names of these firings should be changed in order not to give to the forces on the defensive an exaggerated conception of their safety. Whatever their name, and in spite of the relatively small fraction of the surface effectively covered each minute, such firing nevertheless has some notable advantages. This is true not only because of the ranges at which they can be fired in case of need but also because they diminish the speed of the attack both by their very considerable effect on morale and by the precautions which they impose on the advance when subjected to irregular bursts of fire. Moreover, at the beginning of a campaign, troops are not yet experienced in war.

Shrapnel fired so as to burst *at suitable heights* provides *defensive* fire power to the gun that is markedly superior to that just indicated when firing high explosive shell. Since each shrapnel effectively covers more than a third of a hectar, the four rounds from the battery cover effectively on the average of every fifteen seconds about four thirds of a hectar. As the range dispersion of shrapnel is one and one-half times that of percussion fire the interdiction zone covers one and one-half hectars in frontal fire at 3000 meters. It is thus almost entirely effectively covered on the average of every fifteen seconds. The stopping power of the gun, without attaining the absolute stopping power characteristic of the machine gun at short ranges, is nevertheless considerable *It is even more so in firing from the flanks* since the probable error in deflection is only a tenth of the probable error in range. In this case one gun has the same stopping power for a space of 100 meters as a battery using frontal fire.

WHAT has just been written, however, assumes burst at proper heights. In this connection I believe that I should remark that in 1914 the use of shrapnel was abandoned too quickly in favor of the high explosive shell. In fact, I have too often heard infantrymen and artillerymen express opinions on this subject based on sentiment or on insufficiently analyzed observations. Therefore I would like to have my readers consider the following remarks.

It has often been said that shrapnel generally burst too high and produce no effect. How much too high these bursts were was usually not stated. For instance, the observers forgot to indicate that the average height of burst was, let us say, n meters at a certain range, and did not state how these n meters had been measured. To explain, the effective height of burst of the 75-mm shrapnel, for instance, being 3/1000ths of the range, the average height of burst observed for a range of 3000 meters should be 9 meters. From the battery this would appear as an angle of 3 mils. At a distance of 200 meters, however, it would appear as an angle of 45 mils. An inexperienced observer, remembering the figure of three mils, and located 200 meters from the points of burst, would be inclined to find the average height of burst considerably too high although as a matter of fact it would be excellent.

What difference the erroneous opinion of this observer concerning the height of burst if the effects on the enemy were manifestly insufficient? The objection is well taken, without doubt, but with this reservation, that we know whether the enemy was attacking or whether he was seeking shelter, momentarily to protect himself. In the latter case, the lack of effectiveness observed is not astonishing. *Shrapnel, as a matter of fact, is essentially suitable for furnishing defensive fire power and not offensive fire power for the 75-mm gun.* It must be employed skillfully, and opinions based on insufficiently analyzed observations should not be expressed.

These remarks show the advantage of shrapnel for certain firings to be conducted even in the sections of the front where the offensive is being carried out. For example, for concentration fire on reserves of the defending forces, for a standing barrage on counter-attacks and for interdiction fire at ranges less than 5,000 meters, shrapnel fire is advantageous. Beyond 5,000 meters dispersion in the height of trajectories and in the functioning of time fuzes causes the heights of burst to be too irregular for effective time fire with shrapnel. Beyond 5,000 meters time fire with shrapnel should be demanded only of guns of heavier calibers than the light artillery.

In support of the preceding comments I shall cite the following concrete instance which occurred in the late war. (The cases which I might personally cite would concern smaller units as, then, I was a major or lieutenant colonel). General Franiatte who commanded a corps artillery at Verdun had ordered his organizations to carry out shrapnel firing similar to that just discussed. The firing was completely satisfactory to him. In fact, it was found from examining prisoners that they had been forced to surrender on account of the failure of supplies of all kinds which was evidently

due to the particular effectiveness of the interdiction obtained by the shrapnel fire.

In order to complete the consideration of the use of shrapnel, I should add that the extensive use of this type of projectile during a war depends on the available supply of lead and on the rapidity with which it can be manufactured which is less than that of high explosive shell.

Defensive Fire Power of Heavy Artillery. On account of its relatively slow rate of fire and the positions which it generally occupies, heavy artillery is not well adapted to percussion fire against moving targets such as tanks. However, *on the basis of the expenditure of an equal tonnage of ammunition* it has a stopping power against troops rather comparable to that of light artillery. For instance, the 155-mm French high explosive shell, with time fuze bursting at a height of about 20 meters, results in a "chop" 70 meters wide and 8 meters deep, and a few large fragments will be found as far as 500 meters from the point of burst. Consequently, it effectively covers an area but slightly less than eight times that covered by the French 75-mm. high explosive shell, which weighs approximately one eighth of the 155-mm shell. Firing one round every two minutes so as to equalize the weight of ammunition consumed, for that interval of time, the surface covered per minute by a 155 is equal to the surface covered per minute by the eight rounds of a 75. But with a 155 used alone for a standing barrage, at the rate of fire indicated, successive rounds would be fired at too great an interval. Consequently, if it is desired to use the 155 for standing barrage fire, it is best adapted to reinforcing this kind of fire from the 75 on account of its material effect and its great effect on morale. Moreover, heavy artillery is more generally used to carry out counter-battery fire as well as interdiction and harassing fire at ranges which would be impossible with smaller calibers.

Means of Supplementing Fire Power. Fire power can be made more effective by preventing the enemy from crossing the beaten zone too rapidly, especially if this zone is not very deep, for example, by means of barbed wire entanglements.

Methods of Insuring the Opportune Utilization of Fire Power. Finally, a good defensive fire power, even when supplemented by obstacles, may prove to be insufficient if it is not supported by an organization permitting its operation at opportune moments, regardless of the means used by the enemy to neutralize it, (smoke shell, for example). This organization must evidently depend on a highly developed system of observation adapted to the terrain and provided with all the requisite means of communication.

OFFENSIVE FIRE POWER OF THE VARIOUS WEAPONS. The mere increase of effectives making the attack will no longer suffice to ensure the advance in the face of the formidable fire power which the defensive, as has just been seen, is able to realize in our day. Increasing simply the numbers in the attacking force, without adding the necessary matériel, merely results in increasing the butchery and consequently the cost of failure. In order to advance, it is necessary to destroy or at least neutralize this defensive fire power by opposing to it a greater power of the same kind which may be called *offensive fire power.* Today, the shock resulting from mass and movement cannot replace this power as in the times of short range weapons. In other words, for a successful attack, weapons furnishing offensive fire power are needed. Are those now in existence adapted to this need?

Offensive Fire Power of the Machine Gun. The offensive fire power of the machine gun, i. e., its fitness to destroy or to neutralize an enemy under cover is materially very slight if the destruction of hostile machine guns installed in trench positions, in holes, etc., is contemplated. This is especially true if these machine guns, firing from the flank, are capable of complete protection in the direction of the advancing attack. Machine guns sheltered in this way can, as a matter of fact, be served with the greatest ease and without risk from hostile small arms firing with flat trajectories. Against the machine gun so installed, the machine gun is consequently a mediocre adversary, which means that this weapon has a mediocre offensive power. It is almost equally true against a casemated machine gun firing to the front through a narrow embrasure. In order to hit such a gun the range must be very short and this is a condition difficult to obtain.

ALL this does not mean that the machine gun is able to render only secondary services in the course of an offensive. In fact, as I have noted for the gun in studying its defensive power, the machine gun can be advantageously used even at its longest ranges to make untenable assembly areas for the reserves of the defense, and can hamper to a considerable extent the movements of troops in rear of the front lines. The figures in the following concrete cases prove this: Let us assume a machine gun firing its 480 bullets at a range of 3000 meters in a rectangle 30 meters in width and 400 meters in length. The angle of fall is about 300 mils. Each bullet has a danger space 5 meters long for a man standing, and covers effectively a rectangle 5 x 5 or two and a half square meters. On the 12,000 square meters of the zone of dispersion, 1200 are consequently effectively covered per minute which corresponds to one tenth of the zone of dispersion. Comparison should not be made between the gun and the machine gun in prolonged zone firing at 3,000 meters. Leaving out of consideration the very different rates of fire of the two weapons, it should be noted that I assumed in what precedes for the machine gun, the danger space for the man standing, and for the man kneeling it would be reduced by two-thirds. The high explosive shell, however, is effective even against a man in the prone position since its fragments trace a pattern on the ground whose dimensions were used to calculate the surface effectively covered by the shell. Moreover, machine gun fire at 3000 meters cannot be observed, and consequently cannot be adjusted on the zone to be covered as well as artillery fire. Finally, as will appear later, when it is necessary to cover a zone in which the defenders may as easily be under cover as exposed, it is advantageous to use either high explosive shell with ricochet fire when the angle of fall is less than ten degrees (the case under consideration) or else the explosive shell with time fire up to 4000 meters.

It may be said without making a comparison with the gun which according to the preceding remarks would not be justified, that the machine gun can produce an appreciable effect against targets without cover up to its maximum range.

Offensive Fire Power of the 75-mm Gun. From a consideration of paragraph 2 preceding, it is evident that high explosive shell alone are adapted for use in firing against an intrenched enemy. The offensive power of this shell varies with the fuze used. Accordingly we have the following:

With the high explosive shell, using time fire (combination fuze) the "chop" covers the maximum surface, the fragments falling almost vertically, *on condition that the height of burst is very accurately adjusted, as well as the range.*

With the high explosive shell, using short delay fuze the "chop" in this case also consists of very effective fragments. It is somewhat less extensive than the pattern of the time fire burst but since it is oriented in various directions relative to the plane of fire it has a greater chance of hitting a man sheltered in holes or in variously oriented trenches. Moreover, with this projectile and fuze a time-fire adjustment is not required and it is sufficient that the possibility of ricochet should exist.

With the high explosive shell and instantaneous fuze only a small part of the side spray gives fragments with plunging trajectories hitting the ground moreover very close to the point of burst. Under these conditions a round is *effective only if it falls in the immediate proximity of the target.*

In seeking offensive fire power with light artillery it is consequently advantageous to use, in order of preference, ricochet fire if the angle of fall does not exceed ten degrees, or time fire if the range is less than 4000 meters, as at ranges in excess of this the heights of burst are very irregular, or finally fire with instantaneous fuze.

The high explosive shell with short delay fuze may be used also by the light artillery, when there is no heavy artillery available, to undertake exceptionally the demolitions of important parts of trench systems. I say exceptionally for even by taking in enfilade or by firing obliquely at the element to be demolished, the consumption of ammunition is considerable, especially if the firing cannot be constantly and very exactly adjusted.

Moreover, for neutralization fire on areas it is generally assumed that at least 200 rounds of light artillery or 100 rounds of heavy artillery are needed per hectar and per hour. It is important to consider what may be expected from such firing. If it is assumed that high explosive shell weighing from 5 to 7 kilograms can effectively cover 60, 30 or 10 square meters, depending on whether it is fired as time fire with burst at suitable height, as ricochet fire or as percussion fire with instantaneous fuze, it is seen that with 200 rounds per hectar, per hour each square meter is effectively covered at least once an hour in time fire, a little more than half as much in ricochet fire and only one fifth as much in percussion fire. From this it is seen that the hourly consumption of ammunition per hectar which necessarily varies with the type of fuze used in order to produce the same effect, is large for light artillery. Even under favorable circumstances it accomplishes only a rather intermittent neutralization.

It may become more difficult to neutralize the defense artillery in the future if it disperses its emplacements widely and avoids the heavy concentrations by the artillery of the attack at the same time facilitating the concentration of its own fire wherever needed. I shall show further on that such a problem may be solved very practically by distribution in "orchards of guns" instead of "nests of batteries."

Offensive Fire Power of Heavy Artillery. Offensive fire power of the heavy artillery is analagous to that of the light artillery. It is, however, naturally greater or more extensive without being anywhere near proportional to the tonnage of the projectiles used. It is evidently needed for counterbattery firing on distant batteries, and to execute long range interdiction firing and for the destruction of strong bomb proofs. Interdiction is useful to the defense by forcing the enemy to leave the roads early in the attack. This retards his advance by preventing the assemblage of troops and hampering the movement of his supplies. It is equally useful to the attack to delay the arrival of the reserves of the defense and to hinder his supply movement.

FROM what has been said the following may be concluded:

a. That an *infantry* armed with light and heavy machine guns, with rifles and movable grenade throwers adaptable to rifles, with infantry mortars giving vertical fire up to two kilometers, and with a small caliber flat trajectory gun capable of firing through embrasures against casemated targets and also against tanks up to at least 500 meters, would leave nothing to be desired from the point of view of defensive fire power. In particular the movable grenade throwers adaptable to rifles and mortars in a defensive position can be located well to the front, and abundantly provided with ammunition are able to cover, up to very short ranges, the defiladed ground impossible for flat trajectory weapons. It should be noted in this connection that the high explosive shells weighing from three to four kilograms fired by the infantry mortar with instantaneous fuze have *very large angles of fall,* and give a side spray which is entirely effective against troops advancing *in the open* even when *crawling along the ground.* The heavy machine gun seems to be well adapted for fire against low flying planes which will undoubtedly be more numerous on future battle fields.

b. That a system of artillery having suitably varied calibers and ranges, with extensive fields of fire, both in elevation and in azimuth, has a very effective defensive fire power, particularly when using shrapnel in flank and even frontal fire without having, however, at very short ranges, and arresting power any where near as great as the light or heavy machine gun. With its rapidity of fire and the relatively light weight of its ammunition, the light field gun is especially adapted to carry out standing barrage fire at medium and short ranges, counter-battery fire, especially if the areas to be neutralized are very extensive, and to provide an antitank defense with isolated guns very effective up to 1000 to 1500 meters.

On the other hand, if this artillery is able to provide a good offensive fire power against a protected enemy, on condition that it pay the price by heavy consumption of ammunition and uses high explosive shell appropriately fuzed for the kind of fire to be carried out, the infantry armed, as just indicated, has not much capacity for action against a sheltered enemy outside of its curved fire weapons (rifles and infantry mortars). Moreover, the supply of these weapons during an advance is extremely difficult in the zone of close combat. For this reason it is not advisable to fire on areas with these weapons. Only well adjusted fire should be undertaken and that means that the target must be visible which is rarely possible except at short ranges. Under these circumstances and in spite of its curved-fire weapons the infantry is frequently forced to request the assistance of the light artillery charged with its direct support against the automatic weapons which stop it. Then the question arises of liaison between the infantry and the artillery of the attack, and this will next be studied.

(*To be continued in the next issue of this Journal.*)

Our Thirteenth Annual Meeting

Part I: Proceedings of the First Session and Award of Medals

THE first session of the Thirteenth Annual Meeting of the Army Ordnance Association was held in the Auditorium of the U. S. Chamber of Commerce Wednesday, October 7, 1931. The meeting was called to order at 8:15 P. M. by Brig. Gen. Benedict Crowell, Ord. Res., President of the Association. A verbatim transcript of the proceedings follows:

General Crowell: "Distinguished guests, members of the United States Naval Institute, the National Industrial Conference Board and the Army Ordnance Association, ladies and gentlemen:

"It has been my pleasure for the past twelve years to welcome our members and guests to the annual meetings of our organization. It is again my happy privilege to greet you upon this occasion which marks the opening of our thirteenth annual convention. I undertake the duty with a feeling of pardonable pride in the achievements of our organization.

"Since the World War we have endeavored to emphasize the importance of the munitions problem of our country and through study and application we have tried to aid in the solution of that problem. We have maintained a nucleus of civilians and officers of the services bound together by one common interest—the national defense. We have devoted the technical and scientific energies of our organization to one of the important aspects of national defense—industrial preparedness. With what degree of success we have performed the functions incident to this objective we must leave others to judge. However, I hope I may be permitted to take this opportunity to emphasize a thought which I believe is uppermost in the minds of all of us. It is this: Every phase of the national defense is as vitally important today as at any period in the history of our country. There is such a welter of conflicting doctrine being preached from various sources concerning the function of our defense services and the reasonable state of readiness which they require that those of us who think seriously on the subject may well consider the present outlook as one of major concern. It is not necessary for me to remind you that our organization is not militaristic, it aims at no great standing army nor does it sponsor unnecessary stocks of military equipment. It does aim to keep alive the art of the gun-maker for upon that art in the last analysis depends America's ability to defend herself. Important though other phases of the problem are, we feel that the necessity of a general working knowledge of munitions design, production and supply transcends all other phases of the broad defense question and which we cannot emphasize too strongly.

"The method provided by the National Defense Act of 1920 for what we have come to know as industrial preparedness has placed upon the Assistant Secretary of War the grave responsibility of providing munitions in the event of a major emergency. That task is being performed with the utmost efficiency. It is our function as an organization to assist in whatever way we can and it is a duty which we most gladly accept and shall continue to stress to the best of our ability. After twelve years of effort we can tonight rededicate ourselves to this cause with the same purpose and the same determination which marked our first gathering twelve years ago when the receding shadows of a great World War were uppermost in our minds.

"ON such an occasion it is unusually significant as I see it that representatives of two great national organizations are here participating with us in our annual meeting. It is our good fortune to have as our guests the United States Naval Institute and the National Industrial Conference Board. I am happy to welcome the members of these great organizations.

"It is extremely fitting that we who are pledged thus to industrial preparedness devote this session of our Thirteenth Annual Meeting to a discussion of the problem from the viewpoints of the three major components concerned; namely, the Army, the Navy and American industry. Upon that triumvirate, in equal degree, depends the success or failure of any munitions effort which our country may be called upon to exert in any future major emergency. Consequently we have on our program three outstanding speakers who can speak authoritatively for each of these classes.

"We are honored in having as the first speaker in our discussion of the general topic, "Industrial Preparedness a Coördinated Plan of National Defense," the Acting Chief of Staff of the Army, Maj. Gen. Geo. Van Horn Moseley. It is my great pleasure to present to you the Acting Chief of Staff, General Moseley (General Moseley's address is published on page 168 of this issue.)

General Crowell: "General Moseley, we are very grateful to you for your very splendid address. I need not tell you that the Army Ordnance Association will always coöperate with you and the entire War Department in bringing industrial preparedness for the Army to that high state of perfection which its seriousness demands.

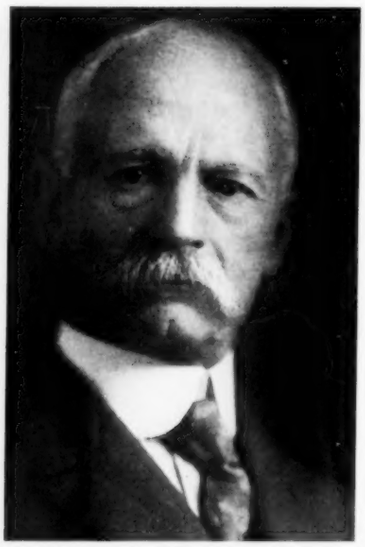
"Another great component in the scheme of industrial preparedness is our first line of national defense, the United States Navy. We are exceptionally fortunate in having as the speaker for the Navy, Rear Admiral Mark L. Bristol, who is chairman of the General Board of the Navy and President of the United States Naval Institute. Admiral Bristol was active in the very first plans which were made for industrial preparedness in the early part of our participation in the World War, and we could have no more important speaker on this phase of the subject than he. The Chairman of the General Board of the Navy, Admiral Bristol." (Admiral Bristol's address is published on page 169 of this issue.)

General Crowell: "To you also, Admiral Bristol, may I extend our sincere thanks for your splendid address? While our organization is primarily interested in the adequate munitionment of the Army, I can assure you that it is no less concerned with the adequacy of the American Navy.

"There is no organization doing a more important work in the economic life of our country than the National Industrial Conference Board. While its investigations and deliberations are essentially concerned with the advancement

Army Ordnance Medalists, 1931

Col. Robert Patterson Lamont



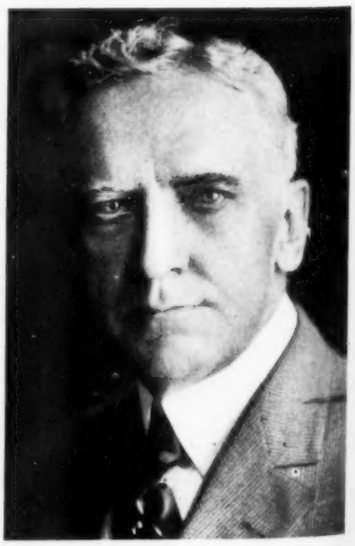
Maj. Gen. William Crozier

Col. William Corbit Spruance

The Medal of Merit

Founded by the Army Ordnance Association 1931. To be awarded annually, upon recommendation of the Committee on Awards and with the approval of the Board of Directors of the Association "for meritorious service to the Nation in peace and—or in war in the field of munitions."

Maj. William Pegram Wilson
1881–1927



Brig. Gen. Guy Eastman Tripp
1865–1927

of our economic life, it has never overlooked the place of industry in our scheme of national defense. We have on our program as the speaker for industry Mr. Magnus W. Alexander, President of the Conference Board. Mr. Alexander was born in New York and at an early age became a resident of Austria where he received his education. He served as an engineer in one of the largest Austrian steel companies and returned to this country in 1894. It is my pleasure to present Mr. Alexander." (Mr. Alexander's address is published on page 171 of this issue.)

General Crowell: "I personally feel that in thanking Mr. Alexander for his very interesting talk that he has rounded out for us the place of the third great component of industrial preparedness. In what he has said there is much for us to think about and act on. First, there is great satisfaction to be drawn from the realization that the Army, the Navy and industry are actively at work in solving a problem which became seriously apparent during the World War and which now is an established doctrine. Further, we should take great pride in knowing that the future defense of our country and of its ideals will include this new doctrine which our experience of the World War proved to be so overwhelmingly important.

"I AM happy to announce on behalf of the Board of Directors of the Army Ordnance Association the foundation of a gold medal to be awarded for meritorious ordnance service. The first awards will be made this evening.

"The purpose of this new medal is to give well deserved recognition of outstanding service to the nation in war and in peace in the field of munitions. No award which our organization can make could be commensurate with the splendid achievement of the individuals to whom the medal will be presented. Rather must we and they look upon it as a slight tribute by which we show our gratitude and our admiration for work well done. The gentlemen upon whom the award will be bestowed personify the highest type of devotion to the cause we all hold dear, and in thus honoring them we bespeak the heartfelt felicitation of our entire membership. They are and were leaders in a great cause and their service is written large not only in the records of our country but even more imperishably in the hearts of their coworkers of this organization.

"The candidates to receive the Medals of Merit were selected by a Committee on Awards of which Col. William W. Coleman of Milwaukee, Wis., first vice-president of our Association, is chairman, with Brig. Gen. Chas. Elliot Warren of New York and Col. Frank A. Scott of Cleveland, members.

"I will now ask Colonel Coleman, Chairman of the Committee on Awards, to present the medalists."

Colonel Coleman: "Mr. President, on behalf of the Committee on Awards of the Army Ordnance Association, of which I have the honor to be chairman, it is my very great privilege to announce that the Ordnance Medal of Merit for 1931 is unanimously awarded as follows:

"For leadership and administrative ability in the progress of munitions preparedness the Medal of Merit is conferred upon Col. Robert Patterson Lamont, the distinguished Secretary of Commerce, for his outstanding service as Chief of the Procurement Division, Office of the Chief of Ordnance, during the World War. Colonel Lamont has served as a Director of the Army Ordnance Association since its organization in 1919 and is a member of the Advisory Board of the Chicago Ordnance District. Colonel Lamont."

Colonel Coleman: "Announcement is also made of the award of the Medal of Merit to Maj. Gen. William Crozier, Chief of Ordnance 1901-1918, for achievement in the invention, design, development and manufacture of military armament, and to Col. William C. Spruance, a vice-president of the Association who served as Chief of the Explosives Section of the Office of the Chief of Ordnance during the World War. Colonel Spruance is the donor of the Princeton University membership endowment to the Army Ordnance Association. The medals will be presented to General Crozier and to Colonel Spruance at a later date as both are unavoidably absent from the country.

"THE Committee on Awards is also most happy to announce that the Medal of Merit is conferred upon two deceased members of the Association both of whom rendered outstanding service to the cause of munitions preparedness.

"Posthumous award of the medal is made to Brig. Gen. Guy Eastman Tripp who died June 14, 1927. General Tripp was Assistant to the Chief of Ordnance in charge of Ordnance Districts in 1918. He was a member of our founders committee and later a director and vice-president of the Army Ordnance Association. In his untimely death our organization and American industry were deprived of the leadership of a man of great ability with whom it was a distinct privilege for many of us to have been associated. The award to General Tripp will be accepted on behalf of Mrs. Tripp by General Tripp's grandson, Master Guy Tripp Hemphill, of New York, whose mother, Mrs. Hemphill, has also honored us by her presence here this evening.

"The Medal of Merit is also posthumously awarded to Maj. William Pegram Wilson, late of the Ordnance Department, U. S. Army, who died November 29, 1927, for his outstanding contribution to the design and development of the antiaircraft director, an instrument basically responsible for much of the progress of American antiaircraft defense. The award to Major Wilson will be accepted by Mrs. Wilson, his widow."

General Crowell: "Ladies and gentlemen: In bringing to a close this first session of our Thirteenth Annual Meeting, to resume again tomorrow morning at 10 o'clock at the Aberdeen Proving Ground, I wish to thank you for your presence here tonight and may I again extend our heartiest appreciation to our guest speakers and to the distinguished ladies and gentlemen who have honored us by their attendance this evening.

"I will now ask the Army Band Orchestra to bring the program to a close by playing the National Anthem, after which we will adjourn to meet again tomorrow at Aberdeen."

In addition to the presiding officer, the chairman of the Committee on Awards, the guest speakers and the recipients of medals, the following distinguished members of the Association occupied chairs on the rostrum throughout the proceedings: Hon. Frederick H. Payne, Acting Secretary of War; Maj. Gen. Samuel Hof, Chief of Ordnance; and Brig. Gens. William H. Tschappat and Edwin D. Bricker, Assistants to the Chief of Ordnance.

Music was furnished by the United States Army Band Orchestra, Capt. Kendall J. Fielder, Commanding Officer.

The Lessons of Our Military Experience

Industrial Preparedness, A Corner Stone of National Defense

By Maj. Gen. Geo. VanHorn Moseley*

I WAS deeply amused today to find in my basket a letter from an association of scientific societies, advocating the passage of a law against long-windedness. I assure you tonight that I am fully in sympathy with such a plan, and that I will not violate even the intent of such a proposed law.

We have finally reached a period in our history when for the first time we have a practical plan for coördinating the war-time needs of the Army and Navy with industry. Such a plan has taken definite shape during the past year, thanks to the loyal coöperation we have secured from the Navy and from industry. Under its provisions we believe that the President, our Commander-in-Chief, can control the whole industrial and agricultural product of the Nation for the supply of our Army and Navy, and for the continuing supply of the civil population as well. Further, he can exercise that control by dealing primarily through one man and one agency under whom all productive activities would be grouped.

Often as we consider the "conditions of the moment" that surround us in our daily lives, real progress seems very slow—sometimes conditions are discouraging but if we in the Army will but look back over a brief period of years, we can see along the trail many monumental stepping stones of progress that mark the route. I want to mention just four of them tonight.

FIRST, when we recovered somewhat from our embarrassment and shame following the Spanish-American War, we instituted a system of Army schools not equalled today in any army in the world, culminating as they do in our Army Industrial College, our Army War College, and in our General Staff Corps.

Second, in that same campaign of '98 our militia system failed us again as it had during the Civil War and before, and to correct this condition we established the principle of national defense on a national basis. The militia has thus been remoulded into the federalized National Guard, a force that proved its worth on many a battlefield in France.

During our preparation for the late war, when we were organizing our great armies, we established the principle of the draft. Never again will we enter upon a great emergency without the application of that fair principle which has become firmly embedded in the minds of our people.

And the last great historical stepping stone is the subject which interests us tonight, that we have builded a practical plan for industrial preparedness for the supply of our forces —a plan fully coördinated with industry and supported by it.

TOO often in the past when the General Staff has worked on maps with its colored blocks and pins in building war plans, it has been prone to skim over two things very lightly —first, the training of the forces involved, and second, their supply. The first problem is being met in our schools and training camps, but the solution of the most difficult part of our problem, the problem of supply, is largely in your hands. We must remember that nations are generally one war behind in equipment, that is, we enter a war with the equipment which came into production during the last months of the preceding war. The critical thing, then, is to have on hand ample ammunition for that old equipment, not only to meet initial requirements but also to meet all our needs until industry comes into production. Fortunately, under the able direction of General Hof, the Ordnance Department is making great progress in putting our ammunition reserve in order and in putting new life into old shells. But if a great emergency comes again tomorrow, the calls from the Army will again be enormous, and again the Ordnance Department will be called upon to do the impossible. If it is properly supported by industry, and if industry has been properly prepared and forewarned, it will actually accomplish the impossible.

You will remember that our good friend General Dawes bought much of our munitions and supplies that were purchased overseas. To him the impossible was always possible and in illustration of that fact, he used to tell a story which I shall tell you now in closing, and in the telling of it you must permit me to use his own forceful words. It was the story of the little boy who was sitting on his father's lap while his father told him story after story. Finally, the father told the boy the story of the little sleepy turtle walking down the trail in the swamp. Suddenly the turtle stopped and looked up, and there, right in front of him, was a great big crocodile with mouth open ready to gulp the little turtle down. The little boy said, "Daddy, what did the turtle do?" to which the father replied, "My son, the turtle ran up a nearby tree and hid in the foliage." The little boy said, "Daddy, turtles can't climb," but the father turned to his son and said, "My son, this —— —— turtle simply had to!"

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*This is an address by the Acting Chief of Staff of the Army to the members of the Army Ordnance Association at the First Session of their Thirteenth Annual Meeting held in the Auditorium of the U. S. Chamber of Commerce, Washington, D. C., October 7, 1931. General Moseley spoke extemporaneously. Army Ordnance has his permission to publish the above stenographic record.

A graduate of the United States Military Academy, 1899, General Moseley is an honor graduate of the Army School of the Line, 1908, Army Staff College 1909, Army War College 1911. Upon graduation from the Military Academy he was commissioned in the Cavalry and promoted through grades to lieutenant colonel May 1917. He was appointed a brigadier general of the National Army June 1918 and brigadier general, U. S. Army, December 1921.

He served as Chief of Staff of the 7th Division on the Mexican Border 1916-17 and was appointed commanding officer of the 5th Field Artillery August, 1917, shortly after his arrival in France with the 1st Division. In April, 1918, he was appointed chief of the G-4 section, General Staff, A. E. F., and was in charge of the strategic supply, preparation for combat and evacuation of the American Army in France. Upon his return to this country he served as commander of the 2nd Field Artillery Brigade in Texas, and in 1921 was assigned as assistant to Gen. Charles G. Dawes, Director of the Budget. He commanded the 11th Field Artillery Brigade, Schofield Barracks, T. H., 1925-27, and the 1st Cavalry Division on the Mexican Border 1928-29. Prior to his appointment as Deputy Chief of Staff, he was executive officer to the Assistant Secretary of War. General Moseley was awarded the D. S. M. for his war service and was decorated by many foreign governments including those of Belgium, England and France.

The Navy: Our First Line of Defense

Measures Adopted for Coördinated Industrial Preparedness

By Rear Admiral Mark L. Bristol*

AS I see it, the purpose of the meeting of the Army Ordnance Association is to acquaint industry, through observation and study, with the war-time munitions requirements of the Army. This commendable effort on the part of the Association is the result of one of the lessons of the World War.

Undoubtedly a number of the industrial executives present can recall without difficulty the complete lack of understanding, both in the service and in industry, of the munitions problem in 1917-1918 as applied to the munitions needs of the United States Government. The industry of this country had been supplying foreign governments with munitions for nearly three years and had been able to keep up with the accelerated demand until April, 1917. Even a superficial investigation will demonstrate that in 1917 the industry of this country was far more familiar with the munitions problem of foreign governments than with that of our own.

As I understand it, the aim of this annual meeting of the Ordnance Association and the demonstrations at Aberdeen tomorrow, is to familiarize industrial executives with the ordnance equipment which they will be called upon to manufacture for the Army in tremendous quantities and in a minimum of time, should war unfortunately come again. In plain words, the object of this assembly is to foster and contribute to industrial preparedness. It is an objective which has the unreserved approval and support of the Navy. The logic and advisability of this objective is questioned by an element in this country which is surprisingly large, considering the bitter experiences of the World War.

However, I do not perceive the need for defending or justifying it before a group of men who do recognize its grim necessity. That is not my purpose in appearing before you. My purpose is to acquaint you with some of the coöperative measures, other than the activities of the Army Ordnance Association, by which the Army and Navy are contributing to a reasonable state of industrial preparedness, and which are therefore indirectly assisting the efforts of this Association.

THE major industrial effort in the World War was to supply the Army. Under other circumstances, had we had no allies, the Navy would have been most vitally involved immediately. The urgent initial demands on industry would have been naval. It was indeed fortunate that this condition did not exist, for the rapidity of expansion of a Navy depends upon the celerity of conversion of merchantmen and upon the construction of new combatant vessels. Taking into consideration the military manpower involved in each service, the comparative demands of the Navy on industry are greater than the demands of the Army under any circumstances, and thus the material expansion of the Navy is, comparatively speaking, the more difficult.

The disposition of the enemy forces determines the service which will have the most urgent initial demands. This fact alone indicates the desirability of complete coördination and coöperation between the two services. The common aim of both is complete and unconditional national security. A lack of appreciation of our joint responsibility prevented this cooperation before the Great War. This condition was undoubtedly caused by our assumed state of comparative isolation from any possible aggressor. This condition of isolation no longer obtains. Methods of transportation and communication have literally cut days to hours and miles to yards. It has been necessary to alter, in a few years, military and naval concepts and doctrines that have been developed over a long period of time. Armies and navies are no longer independent of each other. Coöperation and joint study of strategic, tactical and material problems is the order of the day. There is a growing recognition of the fact that the Navy is vitally concerned with Army wartime needs and also that the Army is vitally concerned with Navy needs. This is a principle that was not even considered seventeen years ago by any military organization with the possible exception of the German General Staff.

Joint study of strategic and tactical problems is being conducted by the Army-Navy Joint Board. That body attempts to determine military and naval situations which will exist under probable conditions of war. The material needs of each service are then determined separately, and tentative recommendations are prepared for allocations of industrial facilities which will be required to produce this material for each service.

IT is obvious that the demands on industry must be coordinated. If they were not, the two services would be bidding against each other. One of the duties of a joint board, known as the Army-Navy Munitions Board, is to coordinate the needs of the two services and to distribute the estimated war load equally throughout each branch of industry. Until a short time ago this was considered the only duty of the Army-Navy Munitions Board. It was considered to be an allocations agency only. However, a growing recognition of the importance of coöperation and coordination between the services developed the true functions of this Board. Not only must the material needs of the two services be determined and coördinated, but also we must be jointly familiar with all industrial facilities available, the

*This is an address by the Chairman of the General Board of the Navy to the members of the Army Ordnance Association at the First Session of their Thirteenth Annual Meeting held in the Auditorium of the U. S. Chamber of Commerce, Washington, D. C., October 7, 1931.

Admiral Bristol was graduated from the U. S. Naval Academy 1887. He has served in all classes of ships of the Navy and at all principal stations of the world. Throughout his service he has been closely connected with the development of modern naval gunnery, torpedoes and aircraft. During the World War he commanded the Oklahoma Battleship Division 6 in European waters. He was a member of the International Armistice Commission, November, 1918, and thereafter commanded the U. S. Naval Detachment in the eastern Mediterranean. He was a delegate to the Lausanne Conference, 1922-23. Prior to his appointment as head of the Navy General Board Admiral Bristol was Commander in Chief of the Asiatic Fleet. He was U. S. Commissioner to Turkey, 1919.

sources of raw materials and labor, the current commercial mass production methods and specifications, and the most equitable forms of wartime contracts. An additional duty of great importance is the joint consideration and development of a comprehensive plan for mobilization of industry as well as the mobilization of the armed forces.

Theodore Roosevelt in speaking of war said, "To an infinitely greater degree than ever before, the outcome depends upon long preparation in advance, and upon the skillful and unified use of the nation's entire social and industrial no less than military power."

The Army-Navy Munitions Board has been recently reorganized by the Secretaries of War and of the Navy. This Board, as now organized, will consider all of the above questions as well as any others which may be presented to it for joint consideration in connection with industrial mobilization.

THE Army alone has concerned itself with this question of industrial mobilization planning since the war and until about a year ago. The need for such a plan was fully developed by the testimony presented to the House Select Committee on Expenditures in the War Department in 1920. The National Defense Act of 1916 was amended in 1920 and delegated legal authority to the Secretary of War to prepare industrial plans to meet the wartime needs of the Army. The responsibility for preparation of Naval industrial plans is not provided for in the National Defense Act, but the two services, Army and Navy, have been actively working together on such plans.

All the files of the War Industries Board and the Council of National Defense were turned over to the office of the Assistant Secretary of War in 1920, and for the past ten years that office has been making an intensive study of the lessons and mistakes of the World War. The product of this study is a comprehensive plan for industrial mobilization. The organizational outline of this plan was presented to the War Policies Commission this past April in the form of a definite statement of policy.

As the study progressed, it was found that the coöperation of other Government departments was needed in order to complete the plan and keep it up-to-date. This need was especially applicable to the Navy, as the material demands of the two services were found to be intimately interrelated. As I have indicated before, the Munitions Board has been reorganized to meet this mutually recognized need for cooperation and coördination in all phases of industrial mobilization planning.

One point I wish to emphasize is that the proposed control over industry and our national economic life in time of war is not to be placed in the hands of a military oligarchy, as some seem to believe. The entire control of all factors of production will be in the hands of civilian representatives appointed by the President. The Army and Navy will indicate their joint needs to this civilian super-agency.

One of the deficiencies experienced in the last war was the lack in both services of a system of promptly determining material needs for a situation which was continually shifting. Any future deficiency of this kind will be avoided to a measurable degree by the training which officers connected with procurement planning receive, and also by training officers from both services at the Army Industrial College.

All of these activities, as well as the work of the Army Ordnance Association, indicate a much more desirable state of industrial preparedness than we have ever known heretofore in our history. I consider that the possibility of confusion, waste of life and time in the initial stages of a future war has been considerably decreased. The result will be that the burdens of a future war, together with the undesirable economic after-effects, will also be considerably decreased.

There is a national feeling today that if it becomes necessary to go to war again, the burdens of war must be equitably distributed to all. That is just. However, there seems to be a universal ignorance of the fact that we are attempting to make provision, not only to more equally distribute the burdens of war, but also to reduce those burdens of excessive cost and loss of life. This is made possible only by adequate preparedness and prearrangement. It has been variously estimated that the cost and loss of life in the last war would have been reduced form 10 to 30 per cent had we made adequate preparation. Unfortunately, as time dims the memories of our past experience, the general trend of education and thought is directed along other channels. The real cause of war becomes obscure and our attention is directed principally to the elimination of the instruments of war.

IT seems to me that there is a form of preparedness which is more essential even than industrial preparedness. The development of an American moral character or a "renaissance of American spirit" is essential to prepare this nation to perform its part in international relations to the end that peace may be maintained. The mentality of the American people today has been developed so that they believe disarmament is the panacea of war. The mentality required is that we stand for justice and right, and, if we cannot obtain these in international relations by arbitration and by peaceful means, we will fight for right and against injustice. There is probably no greater disciple of World Disarmament than Lord Cecil, yet he recognizes the real causes of war. Last June in a speech in London at a conference of representatives of churches as a peace demonstration he stated:

"The very great difficulties about disarmament are essentially moral. They are not technical nor political. If there were ten per cent of Christianity in the international relations of the world, the difficulties of disarmament would melt like the mist before the sun.

"It is the jealousy, suspicion, misunderstanding and evil speaking and slandering that go on between the nations of the world that are the real difficulties."

In a speech broadcast in England and America shortly after the London Disarmament Treaty was ratified, he stated:

"It is well known that no war has been caused by armaments in the last hundred years and it is ridiculous to believe that naval armaments had anything to do with the recent Great War."

Thus, gentlemen, it is my opinion that not only must we have industrial preparedness in the United States, but above all we must have educational preparedness. We must bring our people to realize the moral difficulties in the way of disarmament and have them work for the ten per cent of Christianity in international relations to remove jealousy, suspicion, misunderstanding and evil speaking and slandering which is going on between nations.

Industry in Our Preparedness Program

Military and Industrial Leaderships Pursue a Common Task

By Magnus W. Alexander*

ONE of the most serious of human weaknesses is that careless disregard for the future which results in failure to prepare for the unexpected contingencies of life. Individuals neglect to provide for sickness and old age and, as a consequence, become dependent on public charity. Business men fail to utilize the profits of prosperous years for the creation of reserves and, when depression comes, are forced into receivership or bankruptcy. Nations in times of peace tend to delay the adoption of reasonable measures of national preparedness and, as a result, find themselves in a state of confusion and uncertainty when international conflict arises. In each case, failure to prepare for the future contributes to economic waste and to disruption of the social order.

It is true that the individual cannot foresee the extent to which sickness may exhaust his savings, or how soon the infirmities of old age may diminish his earning power; that the business man cannot predict the duration and character of future economic depressions, or the amount of red ink that may appear in his ledger; and that governments cannot determine in advance the burdens that may be imposed upon them by future wars. Nevertheless, it is possible on the basis of past experience to estimate with reasonable accuracy the current provisions required, in order to be able to meet all of these contingencies with confidence and with the expectation that the major problems arising out of them will be successfully solved. Even though, as Robert Burns has said, "The best laid schemes o' mice and men gang aft a-gley," planning is the only method by which we may hope to cope either individually or collectively with new situations and new problems as they arise.

FROM the angle of national existence, probably no planning for the future is more important than that related to security. To assure security within national borders, a strong and well-ordered government is essential for the protection of the individual and of property and for the promotion of social progress. To assure security in relation to other nations, reasonable military preparedness in time of peace, capable of rapid expansion in time of need, is fundamental. While the need of planning for security has been recognized by our people from the beginning of the national existence, the recent world conflict in the setting of the modern mechanized system of industry, has given a new meaning to that concept, in that it has demonstrated the necessity of closely linking industrial to military preparedness.

In time of peace, military leaders—using the word military as covering both the army and the navy—are essentially business executives charged with the duty of maintaining the efficiency of the organizations under their command. It is also their function to formulate policies intended to provide for the emergency situations of the future, in the same manner that business leaders devise plans to meet changing economic conditions. Thus, their common interest in the problem of efficient organization provides a basis of continuing coöperation between industrialists and military officers, which should prove mutually helpful and of vital benefit to the nation. The ultimate objective of both these leaderships in their search for more efficient methods of organization and coördination is the national welfare. In order to solve the complex economic and political problems which threaten to impede social progress, our country needs men of broad vision to protect and promote both our public and our industrial life. Close contact between men of varied experience in the different fields of activity is, therefore, an effective method for the development of those attributes of leadership that are essential to continued advance in national well-being.

While coöperation between American industry and the nation's military authorities covers a broad field, the chief problem of common concern is naturally the question of industrial preparedness in relation to possible future military operations. Industry recognizes that national security is an essential factor in industrial development. Moreover, the expanding foreign commerce of the United States and the increased investment of American capital abroad emphasize the need for the adoption of measures that will make our government an effective agency for the protection of American interests and the maintenance of world peace. Military strength must be added to the country's economic power to insure world recognition of the government's determination to protect and preserve the rights of its citizens. But industry has an added vital interest in military preparedness because the latter necessarily involves public expenditures that must be met by taxation. As the chief source of the nation's revenues, industry is naturally inclined at all times to emphasize the need for governmental economy and to scrutinize somewhat closely governmental expenditures for military purposes. Moreover, the advantageous geographical position and the extensive natural resources and potential man-power of the United States tend to create a feeling of security in our population, which leads the average citizen to question the need of military preparedness even on the scale of our present peace-time organization. Such criticisms usually overlook the fact that, as pointed out in the National Industrial Conference Board's monthly Bulletin of March, 1930, in reference to War Costs in Peace-Time, the proper test of the magnitude of expenditures for armament is not the money involved but the relation of the money outlay to population and to national income. The Conference Board found that the per capita expenditure for armament was lower in the United States than in Great Britain and France and that, on the basis of the percentage of national income used for such purposes, this country ranked lower than any of the European countries for which data were available. Only Australia showed a slightly lower ratio.

*This is an address by the President of the National Industrial Conference Board to the members of the Army Ordnance Association at the First Session of their Thirteenth Annual Meeting held in the Auditorium of the U. S. Chamber of Commerce, Washington, D. C., October 7, 1931.

Militarism, expressed in the enlargement of our Army and Navy beyond actual needs, has received little support in this country. On the contrary, public opinion is almost unanimously in favor of the principle of disarmament and is willing to proceed with such disarmament in so far as similar action by other nations will permit this without jeopardizing our national safety. It is recognized, however, that international disarmament is not yet in sight. Meanwhile, public opinion in the United States may be relied on to prevent our government from entering upon any competitive program of military expenditure that would encourage the support of militarism among the other nations of the world or within our own borders.

THE recent World War has taught some pertinent lessons. In the field of our national security it has clearly demonstrated that this country cannot afford to rely solely on its vast economic resources and potential man-power for national protection, and that industrial preparedness must be closely coördinated with military objectives, if the latter are not to be unduly hampered or even altogether defeated. The present industrial mobilization program of the War Department is a welcome assurance of the recognition that the lessons of the recent world conflict have not been forgotten.

We now realize that the fundamental difficulties encountered when this country entered the World War in 1917 must be attributed in part to the individualistic character of our industrial organization. This country's traditional policy of enforced competitive rivalry had tended to restrain industrial coöperation. Industry's executives were concerned primarily with their individual problems and only partially interested in the economic relationships of industry as a whole. There was need, however, for more intimate knowledge regarding current conditions and trends in all American industry, in order to facilitate speedy adjustments of industry to the great changes necessitated by our participation in the war. The lack of broad industrial integration tended to hamper the efforts of our government in effectively coördinating industrial activity with the military program.

Another cause of the war difficulties was the absence of established contact between industry and the military authorities. At the outset industrial executives did not have the necessary information regarding the requirements for military equipment and supplies, nor could they know to what extent their productive facilities might be utilized. The military authorities in charge of the procurement of war materials not only lacked the data for determining the quantities currently needed, but were also handicapped by the fact that they did not know what industrial facilities were available for the production of particular supplies or equipment. There was no agency in operation through which such coördination could be promptly evolved; it had to be developed through the slow, costly and painful process of trial and error. As a consequence, there was a period of confusion reaching almost a state of chaos during the early months of the participation of the United States in the World War, and American participation in actual military operations was seriously delayed.

WITH these difficulties and obstacles to prompt and effective coördination of American industry with the Government's military program clearly in mind, we now realize the complexity of the undertaking that the Government faces in its endeavor to provide a scheme of organization that will function smoothly and efficiently in the event of future international conflict involving this country. We have learned that such a conflict means tremendous expansion in some branches of industry and contraction in others, relaxation of established governmental restrictions and imposition of new restraints, partial abandonment of the competitive system, and the introduction of centralized control. Moreover, this process of coördination must become available with great speed and effectiveness, in order that the operations of the Government for the protection of the country may not be retarded by the lack of essential equipment and supplies. To formulate a plan involving an almost complete reorganization of industry, which can be applied at practically a moment's notice and will accomplish the maximum results, is obviously a tremendously difficult task.

Fortunately developments since the unhappy days of 1917 and 1918 have materially changed the conditions that created those war-time difficulties. American industry has become less individualistic and more coöperative and has established closer contact with those governmental agencies which in time of war need the services of the country's industrial organization. The Army Ordnance Association is rendering conspicuous service in this field, by bringing ordnance industrial problems into industry and thus insuring the availability of highly specialized knowledge in the design and production of ordnance material. There is now available a more complete knowledge of the conditions of industry and a better understanding of economic problems on the part of both military and industrial leadership. A basis has been established for prompt adoption of equitable contracts between individual producers and the Government. If industry has not already been adequately studied with a view to its effective utilization for national defense, a survey of the nation's industrial resources should be undertaken by the Government in conjunction with industry's executives, in order to ascertain the extent to which those resources, human and material, will meet emergency requirements.

ALTHOUGH American industry has advanced beyond the stage of extreme individualism, it is still ruled by the competitive principle. But competition needs to be supplemented by coöperation, lest it tend toward disorganization. This is so much the more necessary, if we desire to develop an industrial organization that will adequately meet the tests imposed upon it in time of international stress. Only by the maintenance of close contact between the various branches of industry, and between industry as a whole and those agencies of government concerned with the problem of national preparedness, can the industrial resources of this country be developed into a dependable instrument of national defense and an important factor in the maintenance of world peace.

The old adage, "In times of peace prepare for war," still holds good, but in the practice of this preachment the emphasis has shifted. At present the stress is placed on the maintenance, not of large-scale military establishments in peace times, but of a smaller, highly integrated and efficient organization in which the tactics of industrial production and the tactics of military science are closely joined and military and industrial leaderships pursue a common task.

Our Thirteenth Annual Meeting

Part II: The Tests and Demonstrations at Aberdeen

APPROXIMATELY ten thousand visitors were in attendance at the technical and scientific session of our Thirteenth Annual Meeting at the Aberdeen Proving Ground, Maryland, Thursday, October 8, 1931. Included in the group were members of the National Industrial Conference Board, the United States Naval Institute and of the Army Ordnance Association and their guests who had journeyed from far and near by regular and special trains, by airplane and by automobile. Ordnance Day at Aberdeen was again the common meeting ground for high Government officials and executives and engineers of American industry, for ranking officers of the Army, Navy and Marine Corps, and for the younger members of industrial organizations, of the Organized Reserves and the National Guard—all to witness the progress of American military armament in its relation to the industrial preparedness requirements of the Nation. This great educational demonstration was, in the opinion of many observers, the most efficiently conducted and, from a national defense standpoint, the most significant gathering since the inception of the annual pilgrimage to Aberdeen.

A word can be said at the start in support of this statement. That the meetings of the Association are essentially educational is but to reiterate their fundamental purpose. Each year, through the courtesy of the Secretary of War, our members and guests are privileged to witness current proving ground tests of experimental and standard weapons of the Army. The day of star-chamber proceedings in the engineering advancement of munitions is gone. The men who will make the guns in the event of war, who study their characteristics on paper throughout the year are given the opportunity to see the equipment "in the flesh," to observe its manufacturing requirements and to study the engineering details of its design and fabrication. Ordnance Day epitomizes industrial preparedness primarily because it is founded on this educational purpose.

Further, the physical handling of so huge an undertaking when thousands invade the scientific precincts of a great engineering establishment, is one to tax the ingenuity of any organization no matter how large. The advance planning by the Proving Ground personnel of every detail of safety and convenience, the dispatch and efficiency of conducting the many events of the program and the study required to demonstrate the equipment so that its technical and tactical functions are evident—these are tasks of the first order. They were performed by all personnel of the several branches of the Army in a highly satisfactory manner.

That the affair was of universal significance is obvious. Here were gathered together thousands of American citizens to take stock of our munitions progress. Their very presence indicated the transition from the old order to the new. Men of all walks of professional and industrial endeavor met to appraise the status of progress of our defense machinery, with no thought of domestic or foreign use but simply the better to equip themselves should the day come when they must turn from making the necessities and luxuries of peace to the implements of defense. Few of sober outlook will deny that there is unusual and comforting significance in such a prospect at a time when the very thought of armament seems to be anathema and when at the armament doorstep is laid the alleged cause of all the ills of an otherwise perfect world!

ORDNANCE DAY, 1931, represented further growth in the scope and purpose of the tests and demonstrations. The Ordnance Department of the Army, as the designing and producing agency of our military armament, conducted the current tests of new and standard equipment. It was assisted by participating arms and services including the Infantry, Cavalry, Field Artillery, Coast Artillery, Air Corps, Corps of Engineers, Signal Corps, Adjutant General's Department, Quartermaster Corps and Chemical Warfare Service.

Notable in the items which were shown publicly for the first time was the revolutionary pneumatic-tired carriage which will mount alternately the 155-mm. gun, 1920, and the 8-inch howitzer. By way of contrast two rounds were fired from the 8-inch howitzer, Mark VI—the war-time wheeled carriage which in service is towed by a 10-ton tractor with a maximum practical speed of 6 miles an hour. It has a limiting elevation of 50° and fires a 200-lb. projectile to a maximum range of about 6 miles. The new unit consists of the same calibered howitzer, model 1920, mounted upon a pneumatic-tired carriage and represents the latest thought in design and construction of mount adapting the weapon to high-speed road travel. It has been towed at a speed of 55 miles an hour. With this carriage the howitzer has an elevation of 65° and the range is increased to 10 miles.

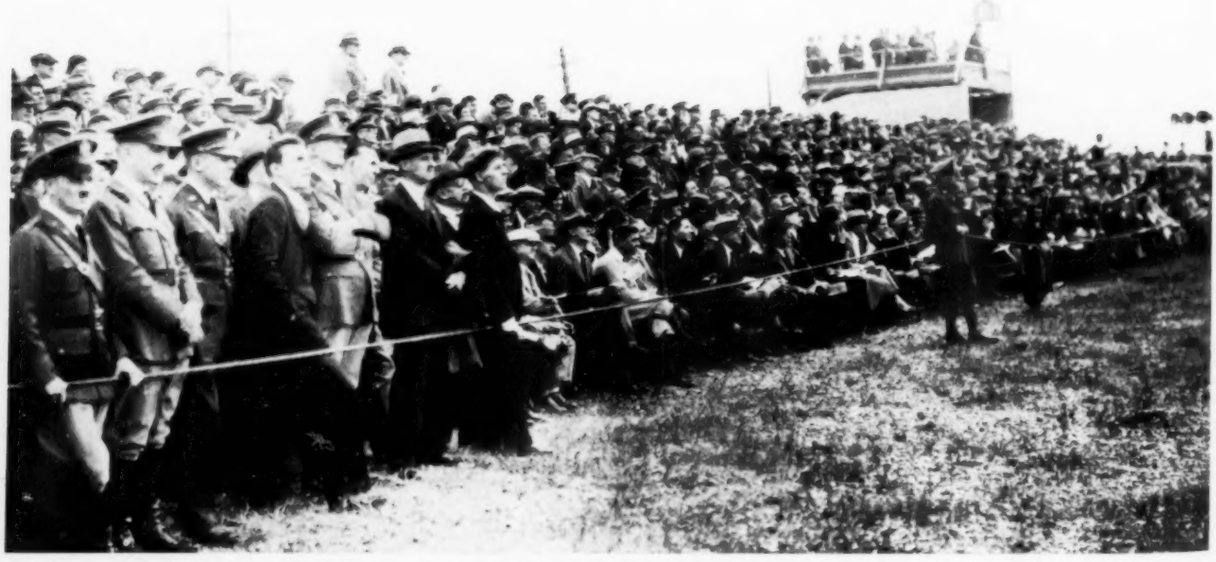
Sharing the limelight in the category of new automotive equipment was the 3-inch antiaircraft gun mounted on a special motor carriage capable of a road speed of fifty miles an hour. This carriage permits 360° of gun traverse and an elevation of 80°. The new Christie medium tank recently procured by the Ordnance Department, shared in the acclaim tendered other automotive fighting vehicles.

The program began promptly at 10 A. M. with an address of welcome by Col. E. M. Shinkle, Ord. Dept., U. S. Army, Commanding Officer of the Proving Ground. Thereafter, in prompt succession throughout the entire day the huge crowd, many of whom were comfortably seated in bleachers at the Main Front, witnessed a perfectly timed and executed series of events, all of which were clearly explained over the Public Address System of the Signal Corps. Small arms matériel demonstrated included recently developed types of semiautomatic shoulder arms, caliber .30 and .50 Browning machine guns firing tracer ammunition and the 37-mm. automatic gun, M1 (A. A.) on T-4 mount using tracer projectiles.

Next in order were artillery ammunition tests illustrating the progress made in the development of propellent powders and showing the outline of trajectory of the 75-mm. gun by firing a series of rounds of shrapnel with the time of fuze-burning varied on successive rounds in two-second decrements. This was followed by a series of test firings of

Scenes at Our Thirteenth Annual Meeting at Aberdeen Proving Ground

A Battery of 3-inch Antiaircraft Guns, Manned by the 62nd Coast Artillery (A. A.) Firing at a Target Towed by an Airplane.



A Section of the Bleachers on the Main Front. Approximately 10,000 Members of the Association and Guests Witnessed the Tests.

The Army's Latest Fighting Equipment on Display

The Pneumatic-tired Carriage, T2, Mounting the 8-inch Howitzer, Model 1920, Was an Interesting Exhibit at the Meeting.

The New Truck Mount, T1, for the 3-inch Antiaircraft Gun During Test Firing on the Main Front at Aberdeen.

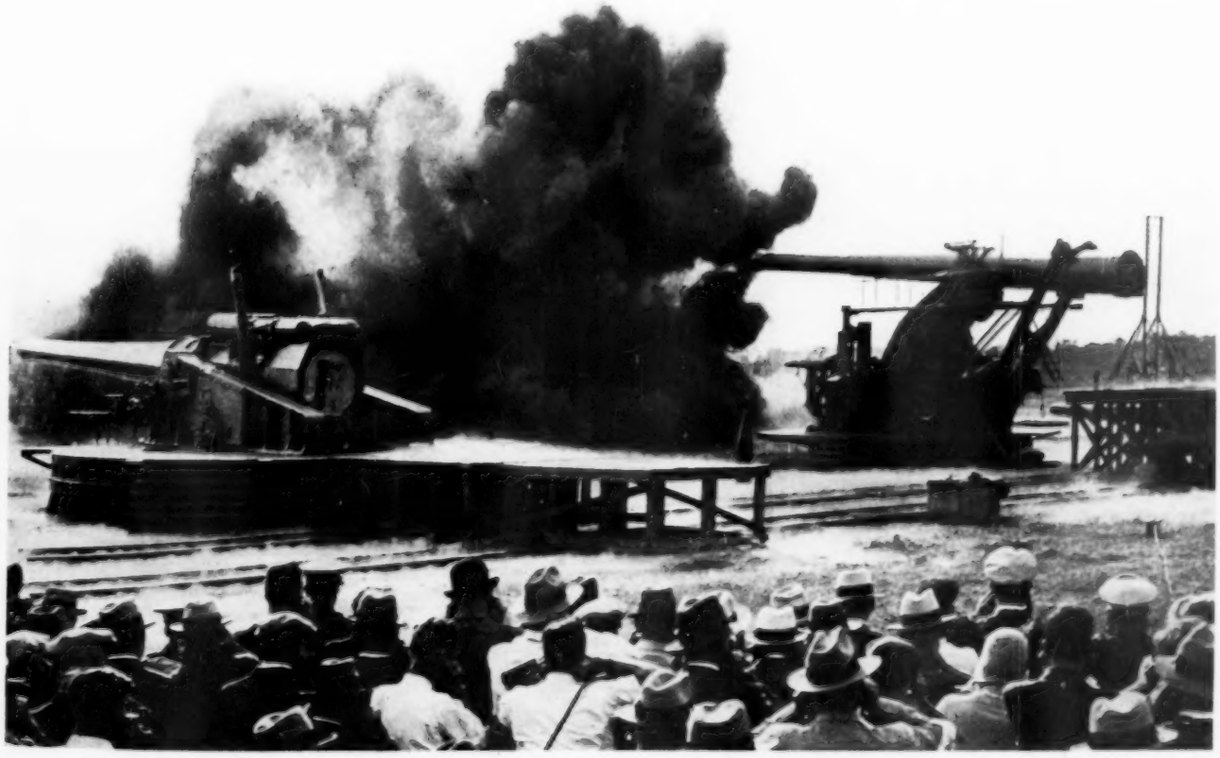
Two New Units of the Automotive Army at Aberdeen

A New General Motors Truck Towing the 8-inch Howitzer Before Members and Guests of the Association at Aberdeen.

Multiple Machine Gun (Antiaircraft) Truck Mount, T2, Daring Firing Tests at the Proving Ground, October 8, 1931.

Members of A. O. A. Study the Engineering Technique of Ordnance

The New Christie Tank, T3, Traveling at 25-Miles an Hour, a Feature of the Automotive Demonstration at Aberdeen.



Test Firing the 14-inch Gun, Model 1910, Mounted on the Crozier-Buffington Disappearing Carriage, Model 1907.

mobile artillery matériel including the 75-mm. Infantry mortar M2, the 75-mm. pack howitzer, M1, the 75-mm. gun M1, the 75-mm. gun, Model 1916 mounted on a standard truck, the 155-mm. howitzer M2, the 3-inch antiaircraft gun on truck mount T1, the 155-mm. howitzer T1, and the 155-mm. gun, Model 1920, mounted on the Mark IX mortar carriage Model 1921. The 4.2-inch chemical mortar developed by the Chemical Warfare Service was also fired.

The morning demonstration was brought to a close by an exhibition of automotive equipment using several types of modern vehicles. Due to limited troops, space and equipment, tactical principles involved in an offensive action were suggested.

The demonstration began with the maneuver of airplanes whose mission was to observe and report upon enemy dispositions. This was followed by armored cars constituting the advance elements of the ground forces. Their mission was to locate the hostile dispositions in considerable detail and transmit this information to troops in rear.

Portée machine guns then proceeded as an advance guard of the mechanized elements. Their mission was to engage the enemy and hold him to his position. Antiaircraft elements then advanced to protect the deployment and advance of the ground forces while light artillery (tractor drawn) occupied position and fired in preparation for and in support of the attack.

Tanks, represented by the T1E1, T1E3 light tanks Model 1923, the T2 and T3 medium tanks (Christie) rushed the principal hostile defensive elements, attacking and crushing machine gun nests and other organized localities. The tank wave was supported by accompanying artillery on self-propelled mounts and by the supporting fire of the advance guard portée machine guns. Dismounted troops, represented by a war-strength platoon of the 1st Engineers (Combat) then advanced on and secured the enemy positions releasing the mechanized elements for further forward movement.

The vehicles used in this and other demonstrations of the morning period and other vehicles of special interest were available for study and examination on the Main Front and in the Museum after luncheon. These included tractors, medium and light tanks, cross-country cargo carriers, motor gun carriages, armored cars and machine gun truck mounts. Several types of trucks were exhibited by the Quartermaster Corps including four-wheel, four-wheel drive, and six-wheel, six-wheel drive, vehicles and a fire truck of the latest series.

During the luncheon period meals were served in dining cars provided by the Pennsylvania Railroad Company and parked near the Main Front. Light refreshments were served by concessionaires. Concerts were given by the 6th Field Artillery and the 62nd Coast Artillery (A. A.) bands.

THE period following luncheon was allotted to the museum exhibits including special features installed by the Recruiting Service, the Corps of Engineers and the Signal Corps. The afternoon program consisted of an Air Corps demonstration participated in by bombardment, attack and pursuit planes from Fort Crockett, Langley, Mitchel, Bolling and Phillips Fields. The guests were then taken to the plate range to witness firings of seacoast matériel, following which the 62nd Coast Artillery (A. A.) gave superb evidence of the ability of that organization and of the efficiency of latest antiaircraft equipment by firing against sleeve targets towed by airplanes. The results of the firing were highly satisfactory. The 3-inch antiaircraft and the caliber .30 machine guns were used. Following a visit to the Aviation Field where various types of military airplanes were on exhibit and parachute jumps and a demonstration of the Pitcairn-Cierva autogiro were given, the guests returned to the Main Front. Because of threatening skies and poor visibility the program of antiaircraft night firings was cancelled.

Among the distinguished guests who attended the meeting were Hon. Frederick H. Payne, Acting Secretary of War; Hon. F. Trubee Davison, Assistant Secretary of War; Hon. Ross A. Collins, U. S. House of Representatives; Lieut. Gen. Gustav Dreszer, Polish Army; Maj. Gen. Samuel Hof, Chief of Ordnance, U. S. Army; Brig. Gen. Benedict Crowell, President, Army Ordnance Association; Brig. Gen. W. H. Tschappat, Assistant to the Chief of Ordnance; Brig. Gen. Edwin D. Bricker, Assistant to the Chief of Ordnance; Gen. John H. Rice, Chief Ordnance Officer, A. E. F.; Hon. Swagar Sherley, Chairman, Appropriations Committee, U. S. House of Representatives during the World War; Col. Wm. W. Coleman, Vice-Pres., Army Ordnance Association; Col. C. L. Harrison, Director, Army Ordnance Association and Chief of Cincinnati Ordnance District; Col. Chas. H. Tenney, Director, Army Ordnance Association and Chief of Boston Ordnance District; J. C. Jones, Director, Army Ordnance Association and Chief of the Philadelphia Ordnance District; Col. Theodore Swann, Assistant Chief of the Birmingham District; Col. B. A. Franklin, Chief of the Bridgeport Ordnance District; Col. M. E. Singleton, Chief of the St. Louis Ordnance District; Lt. Col. Winthrop Withington, Assistant Chief of the Cleveland Ordnance District; Frank B. Bell, Chief, Pittsburgh Ordnance District; Col. H. A. Gidney, Assistant Chief, Pittsburgh Ordnance District; Rear Adm. Wm. A. Moffett, Chief, Bureau of Aeronautics, Navy Department; Rear Adm. H. V. Butler, Commandant, Naval Gun Factory; Brig. Gen. B. D. Foulois, Acting Chief of the Air Corps; Maj. Gen. Harry G. Bishop, Chief of Field Artillery; Maj. Gen. Harry L. Gilchrist, Chief of the Chemical Warfare Service; Maj. Gen. John W. Gulick, Chief of Coast Artillery; Maj. Gen. Stephen O. Fuqua, Chief of Infantry; Maj. Gen. Robert E. Callan, Assistant Chief of Staff G-4; Col. Alfred T. Smith, Assistant Chief of Staff G-2; Col. M. R. Hilgard, Commandant, Quartermaster Corps School; Ogden Reid, *New York Herald-Tribune;* Maj. LeRoy Hodges, Managing Director, Virginia State Chamber of Commerce, Richmond; Col. Wm. A. McCain, Commandant, Army Industrial College; Samuel Vauclain, Chairman, Baldwin Locomotive Works, Philadelphia; and Alexander Dow of the Detroit-Edison Company, Detroit, Mich.

WERE individual acknowledgments and thanks attempted in this place to the many individuals and military organizations who coöperated so splendidly in preparing and presenting the many items on the program, the list would be legion. In again congratulating the War Department and in particular the Ordnance Department, the military and civilian staff of the Proving Ground and the units of the arms and services of the Army, the Army Ordnance Association on behalf of its members and guests cheerfully says "Well done and thank you." Ordnance Day, 1931, presented the Army at its best in efficiency of operation. As an object lesson in munitions preparedness the country was given ample evidence of real progress for which it is grateful.

The War Department Mobilization Plan

The Measures Necessary to Insure an Efficient Defense System

By General Douglas MacArthur*

THE Army procurement program I have outlined to you is paralleled by one developed by the Navy, the two being coördinated in peace by coöperative action between the Departments. Others, that cannot be prepared completely until after the emergency begins, would be those of the Shipping Board and other agencies set up by the government to assist in the prosecution of the war. In addition, provisions must be made to adequately care for the whole civilian population. The need is evident for a closely-knit central organization through which the President can control and direct this whole industrial effort.

Programs to coördinate the tremendous demands upon, and the use of, American industry in war, are designated "Plans for Industrial Mobilization." The Army is, of course, only one of the agencies that must be vitally interested in knowing that such coördination will exist. The Navy Department in particular is giving earnest thought to these matters.

The proposals contained in the Industrial Mobilization Plan, and which I shall outline for you, represent, as far as we have been able to interpret them, the composite views of many agencies and individuals. While the Navy has approved the basic principles of this plan, it has not had sufficient opportunity to express an opinion concerning many of the details. By incorporating in a concrete plan the many ideas and proposals expressed on these subjects, the War Department is making possible a practical coöperation that should finally result in substantial agreements on all important points among interested agencies and individuals.

THIS, the complete War Department Mobilization Plan for both men and munitions in the event of a major war, was presented recently by General MacArthur, Chief of Staff of the Army, before the War Policies Commission. It contains the policies which govern the Department and embodies the thought and study of the years since the World War. Because of the far-reaching importance of the recommendations contained in some of the principal statements before the commission they are being published serially in ARMY ORDNANCE. *The first statement of Mr. Bernard M. Baruch was concluded in the July-August issue.*

The War Policies Commission, composed of heads of Executive Departments of the Government and of members of the United States Senate and the House of Representatives, under the Chairmanship of the Secretary of War, in accordance with Public Resolution No. 98 of the 71st Congress, has this and other testimony before it in the formation of recommended policies in the event of a major war. The first part of General MacArthur's statement was published in the September-October issue of this Journal; the concluding part is presented herewith.—EDITOR.

OUR broad plans for industrial mobilization take cognizance of the genius of American Government and the popular concept of the responsibilities and duties devolving upon the Executive branch in time of war. They have been developed on the following basic considerations: (*a*) Control of industry in war is a function of the President, acting under the authority accorded him by the Constitution, by Congress, and by public opinion. (*b*) The size, and the special and emergency nature of the task of coördinating American industrial effort, demand a special organization, to be made available to the President promptly upon the outbreak of war. (*c*) Plans must be practical rather than theoretical. In the interests of national morale they must operate *justly and distribute war's burdens as equitably as practicable*. They should not contemplate the imposition upon our people of unaccustomed economic processes. (*d*) Emergency measures become effective primarily through the support of public opinion. Justice and fairness, supplemented by strong and intelligent leadership, will be more effective than arbitrary regulations, no matter by whom promulgated.

There are being developed plans for setting up the administrative machinery necessary in war. In the hands of a war-time President there are invariably placed, by the Constitution, by Congress, and by public opinion, a vast responsibility and a corresponding authority. His personal leadership must make itself felt forcibly and instantaneously from the seat of government in Washington to the remotest hamlet of the country. A smooth-working organization, specially designed for the unusual and emergency tasks that will develop, is essential.

It is evident that the existing cabinet departments are not adaptable to the performance of these duties. (*a*) Their functions are specifically defined by law and custom and are not directly related to any of the activities which must be undertaken by the central industrial control in war. In general, they are overburdened by their normal peace-time functions. (*b*) Several of the more important departments exist to serve particular classes, both in peace and war. It would be unfair to expect them to exercise emergency restrictive control over the people that they were created to serve. (*c*) The changes required in our institutions to make use of the cabinet departments as control organizations in war, would be immensely greater than those necessary if a temporary organization is created especially for the emergency. (*d*) The controls and functions under discussion are not and should not be exercised in peace. The emergency organization would automatically terminate after the war. If these controls were exercised by a cabinet department, they might be continued after the end of the war to the great detriment of the country. (*e*) The greatest objection to the use of cabinet departments for war control is the

*Chief of Staff, United States Army.

difficulty of collecting all the scattered agencies and authorities into a focus and directing them toward the accomplishment of a definite purpose.

The existing cabinet departments would, of course, continue to operate in war as they do in peace.

THE proposed organization I am about to describe differs in some details from that of the War Industries Board of 1918, and is more comprehensive in scope. This is because of the changed conditions under which we live. However, those who have made a study of this question will see much similarity between the two.

I cheerfully acknowledge the debt that the government owes to the pioneers who worked out the principles and theories of operation upon which our plan is based.

Director of War Industry. The Director of War Industry is appointed by, and is the confidential representative of, the President. The Director of War Industry is assisted by a small headquarters staff of experts engaged in the continuous study of such matters as price movements and their causes, substitutes for critical materials, conservation, business practices. The main body of this office is made up of two branches—one to coördinate demand, or requirements, the other to coördinate supply, or industry as a whole, in its efforts to meet those requirements.

Organization of Demand. Demand is organized in the requirements branch of the office of the Director of War Industry. This is the part of the organization that includes representatives of the using services. Otherwise the whole organization is civilian.

The Organization of Industry. The industrial branch of the office of the Director of War Industry has a very simple organization. It consists of a Coördinator of War Industry assisted by an Industrial Advisory Board composed of a few prominent industrialists, all selected by the President and assigned to duty as representatives of the government. This organization is charged with the coördination of American industry. Each member of the board is assigned general supervision over a group of War Service Committees.

War Service Committees. Each industry, group of industries, or component part of an industry, is invited to elect for itself an executive or war service committee and to empower it to exercise definite control over the industry and to act for it in designated matters connected with the emergency. War service committees would represent not only manufacturers and distributors but such other interests as transportation, power, labor, and shippers. In fact, any association or organization might appoint a war service committee.

The War Service Committee is thus not a governmental organization. It is elected by and exercises only the powers delegated to it by the industry it represents.

IT could be objected that since this organization is not to be set up until after the beginning of an emergency, time will be consumed in perfecting its details, and the whole machine will have no information, or operational plan on which to start. This has been provided for in the following manner.

First of all the director and his principal assistants will be selected by the President, because of their suitability, and called promptly to Washington. This will be facilitated by the preparation and keeping up-to-date in time of peace of a list of names of men with the special qualifications necessary. A program of this description is now being initiated by the department, and in which the coöperation of national industrial associations and other government agencies will be sought. To provide promptly for each of these assistants, the necessary nucleus of office personnel there will be detailed to each section upon the outbreak of the emergency one of the officers engaged in the peace-time study of the particular matter involved. This officer will secure the necessary clerical help, and transfer immediately to appropriate office space all statistics, studies and plans that have been accumulated on the subject during the planning period. The Navy has agreed in principle to assist in this matter.

To help establish the body of officers from which this nucleus could be secured, there is, in addition to the planning work itself in both services, the Army Industrial College. In this school eminent industrialists annually deliver lectures on appropriate subjects, and discuss present trends in the relationships of government to business. The course gives the student an elementary understanding of the industrial processes in this country.

The nucleus provided in this way will permit the new officials to begin functioning promptly. Expansion will be relatively easy, and it is expected that the Army officers loaned to the organization, except those who must necessarily remain in the Requirement Section, will be returned to us at an early date.

PRACTICALLY every government in recorded history, in peace and war, has attempted to control prices of commodities and services. But the factors of supply and demand and price do not respond readily to government fiat. Hence, almost unbroken failure has followed each attempt. Autocracy compels subterfuge and evasion and dries up the sources of supply. A weak government finds its orders widely ignored.

Yet, a first concern of government is to assure the well-being of its citizens. Hence it must ever seek, so far as possible, a fair distribution of the advantages and burdens of national existence.

War conditions make peculiar demands for government control. Also, then, if popular morale is high, many restrictive measures are feasible which would not be accepted in normal times. Nevertheless, even then governmental effort has never accomplished all that was sought.

Certain conditions in war, particularly in the early stages of war, disturb the price structure or are increased in their disturbing intensity as the price structure itself is upset. They are: (*a*) Unusual governmental demands. To meet these demands we are required to call into production many high-price producers who cannot profitably operate in peace. (*b*) Reckless governmental buying. The government's practice in the end is contagious and leads to, and almost compels, reckless private buying. (*c*) High-cost production due to the necessity of employing unskilled workers as industry expands and workers are absorbed into combatant units. (*d*) Increased insurance, interest, and tax rates as hazards of trade and demands for money increase. (*e*) Restriction or threatened restriction of essential imports. (*f*) Inflation of the currency as the government seeks to finance its augmented purchases, and is increasingly responsive to the opposition to increasing tax burdens.

Our economic experts differ as to the causes and effects

which enter the problems involved in the abnormal conditions. They differ also as to the desirable and effective remedies. They agree that a major factor of disturbance is purely psychological, and that this factor is susceptible to governmental alleviation. Thus, if the government adopts a firm and reasonable attitude—if, in the stress of war, it maintains an air of confidence and calm, then that confidence and calm are usually reflected in the minds and activities and business of the people.

THE War Department has studied widely the story of price-control efforts. It has sought the expert knowledge of men of authority. Its conclusions are: (*a*) Some measures for price control are inevitable and must be taken early in any major war. (*b*) Moderate control undoubtedly can be instituted initially, particularly with respect to basic raw materials. Added control should be undertaken as it becomes necessary, and might finally cover the whole range of commodities. (*c*) Coördination of Army purchasing, as contemplated in the plan, and the elimination of all competitive buying between branches of the Army, will be strictly enforced. A like coöperation and a like freedom from competitive buying among all governmental agencies should be assured through the activities of the Director of War Industry. Thus the government itself would avoid a major cause of price disturbance and would prevent its own agencies from themselves increasing its final costs. (*d*) Governmental departments must have dependable agencies for determination of fair prices. The price offered in any one locality for any commodity must be uniform. (*e*) Prices determined by the War Department for special supplies, and by a control agency for general purchasing, must be set for definite areas and for short periods of time. (*f*) The prices promulgated as fair and reasonable should be determined by agreement between government and the representatives of industry. To facilitate this the plan contemplates a maximum use of fact-finding federal and state agencies and the war service committees. The latter particularly should have detailed data as to price factors and trade conditions in each industrial area. (*g*) Tax laws should be so framed as to require the minimum of inflation, and to recapture all unusual profits. A registration of wealth at or soon after the beginning of any war would facilitate fair treatment and have a salutary effect upon the national morale.

Freezing of prices would appear to be a doubtful expedient because so many factors are involved that injustice must follow. Evasion and court appeals are inevitable. In the end the government's effort would probably be largely gesture. Attempts at enforcement would likely create antagonism, and the government would lose the essential elements of good will. Without complete and unstinting popular support no nation can hope to fight to victory.

Since the Supreme Court has definitely determined that no price-fixing agency of government may set a price on a citizen's property and compel him to give that property to the government at that price, any fixed price is effective in government buying only when it is enforced by public opinion. Beyond this the government is compelled to commandeer—and this as a general method of war-time procurement is not desirable from any standpoint. Forcible taking should be reserved, then, to occasions of real necessity and only as a case of last resort. The citizen's road to judicial appeal should not be made long or difficult.

The principles followed by the Food Administration in the World War must be kept in mind. These were: (*a*) To take into account the interests of both producers and consumers and so enlist the support of each. (*b*) To depend for enforcement *upon the popular morale and collective patriotism*. (*c*) To move commodities in as direct a line as possible from producers to consumers. (*d*) To prevent hoarding and waste. (*e*) To minimize the evils of dealing in futures. (*f*) To permit reasonable profit based on costs and to disregard replacement values.

The War Department plan for procurement provides fully for a proper and considered distribution of the war load. It provides facilities for the determination of reasonable prices to be paid for special equipment. Our proposals include the setting-up of an agency to determine prices for general governmental buying. The plan places no handicap before the citizen who wishes judicial determination of the fairness of the price given. It assures intelligent and conservative buying, thus it avoids needless burden on the industrial structure; thus, too, it prevents the creation within business of fantastic notions of the extent of the government's needs. It provides for a reduction of the contractual hazards of war production, thus eliminating the necessity for consideration by contractors of excessive factors of safety in bidding. It provides for prompt and final settlement of contractual claims, thus making unnecessary an estimate in the contractor's bid of an amount which will compensate him for the delay in receipt of money due.

The industrial plan assures that the government itself will not unnecessarily upset economic and industrial conditions. Price control efforts, in consequence, will be directed gradually, and in general recognition of their necessity and reasonableness. Good will and cordial acquiescence will assure their success. Injustice and harshness will be avoided because in the determination of prices industry will have voice. The spontaneous coöperation born of patriotism and enthusiasm will not degenerate into an enforced and begrudging compliance. Production will proceed quickly and efficiently and economically. Finally, the citizens will feel that the restrictions to which they submit are restrictions they themselves have imposed in the interests of the common welfare.

PRIORITY is a method of control that was widely developed in the World War, particularly by the War Industries Board. It was used mainly: (*a*) To direct the flow of materials and services into the channels of supply of the war-making agencies. (*b*) To divert the use of resources from non-essential needs into channels of essential production. (*c*) To assure the equitable distribution of materials and services to the civilian population.

In war the primary national interest is a speedy and successful termination of military effort. Every citizen recognizes the paramount right of government to the use of anything which assures early success in war. Our laws are fashioned in the knowledge of the popular recognition of the fact that in war the individual must give way to the nation and must forego some of the personal liberty and security he demands in peace.

Since the demand for essential commodities becomes imperious in war, some agency must distribute equitably available supply to recognized need. Thus the greater need takes precedence over the lesser need, the immediate need over that which may safely wait. Also, those things essential

to national life and effort are preferred to those which are not so insistently important.

Priority does just that. Wisely and sympathetically administered, it facilitates maximum military effort at minimum burden to all, and assures to each individual need a reasonable share in the common supply.

The plan presented provides definitely for the exercise of priority determinations as between the respective needs of government agencies and as between government and civilians through the Director of War Industry.

EFFECTIVE use of labor in industry, in wartime as in peacetime, can be had only through labor's voluntary cooperation. Any system of forced labor, either by conscription or otherwise, could result only in failure. It would not be supported by public opinion and, even though tolerated by a people at war, the resentment of the workers on whom it was imposed would be a direct source of inefficient operation.

It is anticipated that, as the determination of peace or war rests with the elected representatives of the people, the full coöperation of labor, equally with that of other elements of the population will be accorded to the war and to the government.

Nevertheless, there will remain the need of governmental organizations to protect labor from oppression under color of the emergency and to guide labor into useful channels and to retain it therein so far as possible. This sometimes is referred to as the control of labor, but it is based entirely on securing voluntary coöperation.

The Labor Administration. The mission of the Labor Administration is to assure war industries and essential civilian industries, including agriculture and transportation, of the supply of labor in numbers, and of occupational qualifications, required for adequate operation.

The Labor Administration will be headed by an Administrator of Labor appointed by the President, to whom the administrator will be directly responsible. He will be assisted in the formulation of policies and plans by an advisory council consisting of representatives of employers and employees in equal numbers.

The primary means of enforcing decisions of the Labor Administration will be the force of public opinion, though it is not anticipated that even this force will be required if a proper organization, functioning smoothly, proves itself a competent guiding hand.

The essentials of such an organization are machinery for the determination of labor requirements, an employment service to bring the job and worker together, and a conciliation and adjustment service to keep the job and worker together as long as this may be reasonably possible.

WE do not propose the initial organization of an independent fuel administration or a food administration because we believe that ordinarily the Director of War Industry would be able to furnish all the control necessary in these matters. It is *not* proposed to take over the railroads in time of war unless such action is unavoidable. There exists a definite plan for the operation of railways in war, already described to the Commission by Mr. Willard and Mr. Aishton. The railways and the War Department cooperated in its formulation, and the plan as submitted and recommended is believed to be practical in every respect.

We have made provisions for a War Trade Board, and for a Director of Public Relations. The functions of both will be of great importance, but are sufficiently described by the titles given for the purposes of this discussion. There will also be set up such governmentally-owned corporations as may prove to be necessary.

Congressional authorizations would be necessary before certain parts of the plan I have sketched for you could go into operation. We have assumed that these authorizations would be promptly given provided appropriate Congressional committees, during years of peace, approve of the details of plans and proposed bills. Tentative drafts of proposed legislation are attached to the plan already furnished the Commission. It is felt that the enactment of *detailed* laws at a time when war is not imminent is not desirable, because such action would probably result in enactment into law of measures so rigid in their provisions as to be a hindrance rather than an assistance in the changed conditions of any future emergency. Certain laws, general in their provisions, would unquestionably serve a splendid educational purpose, and would clarify some doubtful points that impede progress in planning. However, the passage of such laws might be held by some to be an indication of lack of good faith in our professions of desire for peace.

IN the foregoing discussion I have sought to describe briefly War Department planning activity that is intimately related to the problems for which this Commission is seeking solutions. It is obvious that some of this activity lies outside the scope of War Department fixed responsibility. The reasons for this apparent inconsistency are easily explainable.

In the actual conduct of war armies and navies and their supporting air fleets are but important elements in the whole war-making team. In time of peace, however, only the War and Navy Departments have direct legal responsibilities affecting the national security, and only in these services do we find specific planning against the possibility of aggression. These departments take the lead in order to secure, and translate into concrete plans, opinions and data from many sources affecting the functioning of some of the other governmental agencies in the conduct of war. Otherwise such plans would probably be neglected, and consequently unavailable when needed. Speaking generally, therefore, the plans of the War and Navy Departments must cover the whole range of essential war-time activity.

It must be apparent that the theories and principles on which our plans are based do not differ essentially from those expressed by the majority of the witnesses who have previously appeared before you. The goal we seek is that sought by the men responsible for the drafting of Public Resolution No. 98. Our plans simply set forth the methods whereby it is believed these principles and theories could be applied in the event of another great emergency.

We would be bold indeed to maintain that the methods so proposed are in every case the best. It may perhaps be charged that our plan is too conservative. But it is to be remembered that in case of need the War and Navy Departments must be ready to place these plans before the President and before Congress with the recommendation that they be adopted to govern the conduct of the war. Our responsibility in this matter is too great to permit the inclusion in our plans of any proposed policy of whose successful operation in war we do not feel we can give assurance.

Certainly, our plans are the result of honest effort. They are developing along lines that we believe experience has pointed out—and present conditions dictate.

Progress in this work demands but insignificant amounts from the public revenue. Study, thought, and research are required, and these, to the best of our ability we are giving.

I think it pertinent also to say here that the voluntary assistance we constantly receive from other departments, from associations, and from patriotic industrialists, is of the utmost value and is fully appreciated by the government. We are studying ways and means through which this assistance may be more efficiently organized—and so facilitate crystallization of information and opinion, and promote mutual understanding of these important subjects.

THE Department's conclusions concerning the problems facing this Commission are as follows:

Educational programs concerning the true meaning of modern war and its certain results in human and economic wastage are conducive to promotion of peace.

Reasonable measures for defense are indispensable to a peace-minded nation as a deterrent to any possible aggressor and as a nucleus upon which to expand in case of need.

Modern war demands the prompt utilization of all the national resources. Measures for transforming potential strength into actual strength must work in emergency with the utmost speed and effectiveness.

The greatest need of a nation at war is immediate and decisive victory.

Public opinion is the most potent force in war. The United States will never enter a war except in response to insistent popular demand, incited by foreign aggression, and consequently the government will have initially the complete support of a high national morale. Maintenance of this morale will depend upon the effectiveness of national efforts against the external enemy and upon the justice and fairness of governmental programs as applied to our own population.

The human burdens of war must be equalized in so far as possible. To this end liability for combat service must be determined under a selective service system developed along the general lines of that used in the World War.

The economic burdens must be equalized through: (*a*) Systematic registration of wealth and all accretions thereto during the period of the emergency; and tax legislation framed to place an equitable burden thereon. (*b*) Orderly and economic procurement by the government itself. (*c*) Strong and intelligent leadership based on exact information and exercised through an organization adapted to the purpose. (*d*) Application of governmental controls to meet requirements of the specific situation and to prevent any profiteering at the national expense. (*e*) Prompt resumption of normal peace conditions upon the termination of the war. During the progress of any war the President should appoint a committee to study and prepare plans for demobilization. These plans must facilitate the re-employment of men returning to civil life from the Army and Navy, and the freeing of industry of the accumulations of stocks produced to meet war requirements.

All of the above demand an intensive and intelligent planning program carried out continuously in time of peace. This planning is the responsibility of the whole federal government, which should seek the advice and assistance of civilians in all walks of life. Because of their peculiar responsibilities, the War and Navy Departments must be definitely required to carry on this work as the agents of the whole government.

Congress should satisfy itself at frequent intervals as to the progress of plans under development by requiring their presentation to appropriate committees of Congress. This should include the presentation of all proposed emergency legislation.

THE War Department recommends that, in answer to Public Resolution No. 98—71st Congress, a like joint resolution be adopted by Congress which will make public announcement to the nation of the policies set forth in the foregoing conclusions. It is recommended also that these policies be grouped in the following three categories:

Group A—Those policies which will assure practical and efficient peace-time preparation for the emergency of war, promulgated and published in such a way as to have a serious, sobering effect upon every man, woman and child when he or she contemplates the possibility of war.

Group B—Those policies which will facilitate the successful conduct of war and effect a just and equitable distribution of war's human and economic burdens when once it has been deliberately undertaken.

Group C—Those policies which will enable the nation to demobilize after a war in a rational and orderly fashion.

In closing I want to present a copy of the War Department Industrial Mobilization Plan; a document prepared as a statement of policy upon which detailed plans are based. Attached to it is a brief statement of the legal principles and rules upon which it rests. I recommend inclusion of both these documents in the printed record of your proceedings as appendices to, and in explanation of, my verbal statement. (*This concludes General MacArthur's statement.*)

The Veteran Corps of Artillery, New York

An Historic Organization Whose Ordnance is Always Up-to-Date

By T. M. Parks*

TODAY, with Thompson sub-machine guns, 45's and 38's, the Veteran Corps of Artillery, State of New York, keeps up its marksmanship and trains for future service to State and Nation. In 1917, this time-honored organization was armed with Krags and Lewis guns as an antiaircraft battery in State service, and with Springfields in Federal. After '98 it was organized as a Gatling gun battery. Farther back, for over one hundred years there were no 4th of July parades in New York City without the Veteran Corps and, during the early part of that period, its two muzzle-loading brass 12-pounders.

Capt. John McLean
Commandant of the Veteran Corps of Artillery, New York, 1809-1813.

Its history embraces the entire range of ordnance from muzzle-loaders to sub-machine guns! History records that in 1812 of the many militia units in the city "The Veteran Corps of Artillery in New York City was the first militia organization to take active measures for the defense of the city," assembling under their then commander, Capt. John McLean, on June 25th and taking up their station in the North Redoubt, New York Harbor, at the spot where the first shot was received from the S. S. ASIA at the commencement of the Revolution. And before that, from 1790 until the War, Independence Day and Evacuation Day always saw the Veteran Corps turning out armed with flint-lock muskets and "firing a national salute from the heaviest pieces in the city's defenses!"

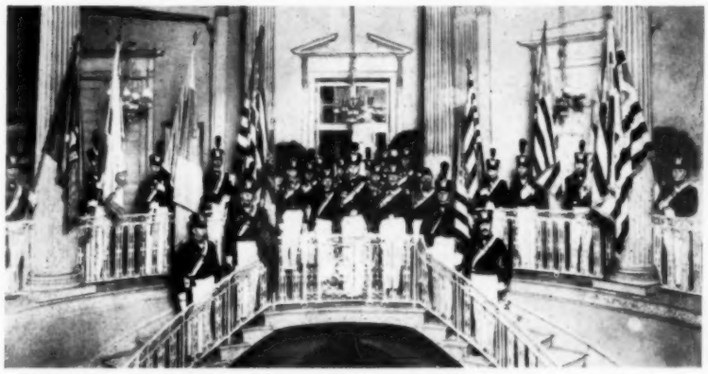
When misinformed persons think our comparatively young nation is without traditions they reckon not with this venerable organization which, besides having served as a unit in two wars over a century apart—1812 and 1917—has numbered in its membership men who served in all major conflicts of this country from the French and Indian War to the present day. They were the recipients of the Congressional Medal of Honor, the Distinguished Service Cross and Medal, the Legion of Honor of France, New York's own Conspicuous Service Cross, and awards and decorations from various states and foreign governments. Moreover, the corps was given a place of honor in the final tributes to such notables as Maj. Gen. Richard Montgomery, at whose funeral the orders read: "The Veteran Corps of Artillery is detailed to fire the signal guns at the Arsenal and minute guns from Fort Richmond at Staten Island." In the procession for the Marquis de Lafayette the pallbearers were officers of the Revolution and the Veteran Corps of Artillery. During the funeral of Maj. Gen. Andrew Jackson it was ordered: "The Veteran Corps of Artillery will fire minute guns, answering in number to the age of the deceased." It was also the privilege of the Corps to have charge of the funeral of an inconspicuous private from the ranks whom Fate had spared to receive the most unique honor of all of the hundreds of thousands of men who participated in the War of 1812 in the armies and navies of our infant republic. Although we have had 101 wars, great and small, we hardly remember more than three prior to the Civil war—'75, '12 and '46—and each had its ranks thinned down to the single, solitary, last survivor—the man who of his host stood alone. It was the privilege of the Corps to bury Hiram Cronk—the last pensioner of the War of 1812.

IN the organization of today there are, appropriately, many members of Coast and Field Artillery regiments of the National Guard and Organized Reserves, some of whom on occasion train with ordnance which fires projectiles exceeding in weight the entire gun and carriage of their predecessors. Yet well may they look to their laurels when compared to the days of "iron men and wooden ships," little brass smooth-bore cannon firing round solid shot weighing as little as four pounds, or grape and cannister at point blank ranges, aimed along the "line of metal" of the sightless barrel of the older pieces, aligning notches in the swells at base and muzzle and guessing the elevation, or using the "gunner's quadrant," a device which resembled a carpenter's square with a plumb line attached. Conspicuous among the early leaders were Capt. Francis Monty, Quartermaster of the Veteran Corps of Artillery from 1801 to 1809, and Capt. William Stevens, its Commandant from 1796 to 1798.

Of Captain Monty, history records, during his service with the Canadian Regiment, Continental Infantry: "Meanwhile H. B. M. Sloop of War VULTURE came up from New York Harbor to Haverstraw Bay in the Hudson River with Maj. John Andre, Adjutant General of the British Army, who on the night of September 21, 1780, had landed on the western shore and was in treasonable plotting with Maj. Gen. Benedict Arnold. Colonel Livingston, of the Canadian Regiment, having determined to drive the VULTURE from her anchorage, sent Lieutenant Monty with a 4-pounder field piece and gun detachment to Tellers Point to open fire on

*Hereditary Member, Veteran Corps of Artillery, S. N. Y., Captain, Quartermaster Reserve, U. S. Army.

the sloop. So vigorous was his fire that the vessel was hit several times and had to quit her anchorage and drop down the river. This prevented Major Andre from returning in safety and compelled him to cross the Hudson River and proceed to New York by land, during which he was captured at Tarrytown, tried by Military Commission, convicted and executed under the Laws of War as a spy."



The Veteran Corps of Artillery, New York, as a Guard of Honor
Reception to Marshal Joffre and French Envoys at the City Hall, New York City, May 9, 1917.

Capt. Stevens' marksmanship, while not resulting in so conspicuous a result, is recorded as follows: "He was renowned in the main Continental Army as an accomplished artillerist and, at the siege of Yorktown particularly attracted the attention of the American and French armies by the extraordinary precision and effectiveness of the fire of the 18 and 24-pounder siege guns sighted by him when in charge of a siege battery."

Our histories do not make clear that after the peace of 1783 King George III's government did not consider us a free nation and would make no treaty of commerce with us, thus seriously handicapping our trade. Also, the frontier forts, in violation of the treaty, were still held by the British in 1790, Indian tribes were armed and encouraged to attack the settlers, American seamen were taken from our ships and forced into British naval service, and the Tories in New York, who had so thoroughly established themselves during the British occupation of 1776 to 1783, confidently awaited the speedy return to British government.

However, the veterans of the Revolution in the city, including men who had served from the Lexington Alarm through to Yorktown, men who had been on the 19-mile march from White Marsh, Pa., to Valley Forge when hundreds were shoeless in freezing weather and marked their route with bloody footprints, men who had fought so hard and so long —viewed with alarm the indications that their sacrifices might yet prove in vain and set about to offset their disadvantages. Especially dangerous to the future of the Nation was the defenselessness of the city which in 1790, it is to be remembered, was the capital of the United States as well as of the State of New York, with its defensive works decaying and only an insufficient militia for emergencies, the little Regular Army of the United States being all on the Western Frontier.

Evacuation Day, because it marked the end of the occupation in 1783, was in those days almost of greater patriotic significance to New Yorkers than the 4th of July. Consequently the situation in 1790 was uppermost in the public mind on Evacuation Day, November 25, when a number of officers and soldiers who had served honorably in the War of the Revolution, and some of whom were exempt by law from militia service, met at the City Arms Tavern, at the corner of Broadway and Thames Street, and voluntarily associated themselves into an artillery organization, of as many companies as might be necessary, by the name and title of "The Veteran Corps of Artillery of the State of New York." The Artillery Corps formation was provided for in the resolution of the Continental Congress of December 27, 1776 under which the Continental Corps of Artillery of the Revolution was organized. Its membership consisted of 921 veteran original members of the War of the Revolution, mostly resident in the counties of New York, Richmond, Kings, Queens and Westchester. The approval of the Governor of the State and the recognition of Congress were promptly received.

The Corps still carries sabers with shoulder belts and marches to the shrilling of fifes and the rattling of drums, while true to the style of artillery uniforms of that period, the uniform of today is not exactly that of the original organization. Guernsey, in "New York City During the War of 1812" relates: "They usually wore on parade a sword with shoulder belt and a Revolutionary cockade with '76 in gilt on it, and a blue feather with a red top on the side of the hat. When there became a prospect for actual service after declaration of war a new uniform was provided. It was a Navy blue coat and white pantaloons, white vest, black stock, black hat and a black feather with a red top, cockade, bootees, and side arms, yellow mounted."

Full Dress Uniform of the Corps
A Private of the Veteran Corps of Artillery, New York.

IN the garrisoning of the harbor defenses in 1812 regular and other militia bodies were side by side with the Corps in manning the guns and the identity of the pieces originally served has been lost. However, it is certain that they were not greatly different from those of the Revolution although there had been some improvements, notably the system of sighting known as the "tangent alignment," the "gunner's rule," and methods of casting large iron guns. Also, flint-lock firing mechanisms were available but it is most probable that few if any of

these were in actual use in the American coast defenses or Navy and that they continued loading their guns from the muzzle, aligning by notches, elevating by blocks under the rear end known as "quoins," and firing by touching a "slow match" to the powder pan. It is said that during continuous firing the guns became so hot that they fired automatically when air was admitted by removing a wooden spike from the vent. The progress of heavy ordnance was slow until the advent of smokeless powder and as is well known, in the Civil War fifty years later, brass and bronze smooth-bore muzzle-loaders with only slight improvements were still in use.

Brig. Gen. Chas. Elliot Warren
Colonel-Commandant of the Veteran Corps of Artillery.

The main difference between the artillery of 1775 and 1812 was the size and range of the pieces, and a limited supply of shells the bursting of which was controlled by fuses. Naval engagements were still mostly boarding affairs and "carronades," of large bore and short barrel, the chief armament of European navies. American privateers, however, had carried to their artillery the lessons learned in the forest of the superiority of the long-barreled musket over the carbine and favored the "Long Tom" style to the carronade. "Old Ironsides" carried a heavy complement of both and won her name while standing off nearly out of "carronade" range, her shots doing fearful execution and some of the enemy's balls being seen to bounce off her stout wooden sides and fall in the water, too spent to penetrate her indomitable beams.

In the light of present day marksmanship-practice on hulks by airplanes and big guns, that of 1812 is interesting by contrast. Guernsey records:

"On August 14, 1812 there was target practice by the Artillery Militia from Castle William and the fort at the Battery. The target was an old hulk anchored in the bay about 1000 yards from shore, equidistant from both forts. The stern of the vessel was presented for target and the firing commenced by General Morton's Brigade from 6, 9, 12 and 18 pounders stationed on Battery Parade. The Veteran Corps of Artillery, commanded by Capt. John Delamater, fired from a 'long nine' which raked the hull of the target repeatedly. The detachment from General Morton's Brigade on duty in the fort at the Battery also fired several shots which passed through the hull, and several shots from the guns in Castle William also hulled the target. After the firing had continued two hours the hulk was perceived to be on fire. This was caused by a few hot shots fired by Colonel Curtenius' Regiment, the 3rd Artillery, which were heated in a travelling forge attached to the Brigade. No hot shots were fired from the forts. After firing had ceased a number of officers went on board and it appeared that almost every shot had done considerable injury as there was not a place four feet square which had not been struck or perforated by shot.

"The following is a detailed statement of the result:

	Guns	Hits	Misses	Total Shots
Castle William	36	27	3	36
Fort at Battery	40	36	4	40
Artillery at Battery	244	191	53	244
	314	254	60	314

"The next morning one of the City's daily papers said of the firing: 'We congratulate our fellow citizens on the evidence they afforded that we are possessed of adequate means for defense of our harbor and that it depends with ourselves whether New York shall become at any time the victim of foreign rapacity.'"

Again on November 1, 1813 target practice was held in the Harbor by four batteries, one of eleven 12-pounders and the other three of four 13-pounders, at a small sloop which sank after 88 shots. Of about 90 shots fired it was estimated that 50 struck her and that if the target had been a ship of war, instead of a vessel of 60 tons, nearly every shot would have done execution.

The following comments were made at the time.

"Justice requires us to notice the excellent firing of the Veteran Corps of Artillery, commanded by Captain Chapman, which did much execution."

"General Dearborn has the pleasure to announce to Brigadier General Morton, of the First Brigade of New York State Artillery, the high satisfaction he experienced in the review of his Brigade. Their appearance was in every way military and their firing at the target would do honor to the oldest artillerists. He observed with peculiar pleasure the Corps of Veterans who, at an advanced period of life, evince a determination to be first in the defense of their country and its rights."

After Governor George Clinton on March 8, 1791 by virtue of his prerogative confirmed The Veteran Corps of Artillery, S. N. Y., as a separate and distinct corps in the active militia, and for a number of years thereafter, The Artillery Service Detachment of the Corps, then composed wholly of veterans of the War of the Revolution, formed three regiments, exclusive of those veteran members who were incapacitated for field service by reason of wounds or other physical disability. It is to be noted here that the War of 1812 was thirty years after the end of the Revolutionary War and that few of the members were under fifty years of age when they participated in the voluntary turn-out for target practice described above, which accounts for representation by a single battery.

Gradually, as the Service Detachment became reduced in numbers by the decease of its veteran members, or their inability longer to do duty, consolidation in formation was effected and supernumerary officers and companies were discontinued as the membership shrank. In 1848 the Corps

merged with the Military Society of the War of 1812, an organization of officers of that war founded in 1828, and thereafter continued under the dual name. The Service Detachment was again recruited up to three regiments but after 1855 their numbers diminished so rapidly that by 1864 the Corps could only parade about five hundred veterans, from 70 to 90 years old, and the State did not require from them further military duty until 1890. In that year all original Revolutionary War Veterans having passed on, and the membership having shrunk to less than a score of 1812 veterans, it was decided to perpetuate the organization by admission of descendants of the original Revolutionary members and of officers of the War of 1812. For a time this brought a satisfactory increase in membership but later eligibility was modified to include descendants of officers and soldiers of both wars. In 1917 the membership totalled over 200, of whom 41 were in the Artillery Service Detachment, organized as a Gatling Gun Battery with four old caliber .50 guns. This small, select, rather ornamental 41-men unit, in its antiquated full-dress uniform, was, with the waiving of the hereditary eligibility, expanded into a well armed, well trained, olive-drab uniformed regiment of twelve batteries, 1438 officers and men, and offered to the State to serve in the absence of the National Guard, then in Federal service.

As in 1812, when the Corps had been recruited from among men exempted from compulsory service, so in 1917 it was decided to again take men who were either exempt from the draft or in deferred classes, thus to avoid keeping men from the Army and Navy and to build up a home defense force which would remain after all other troops were withdrawn. In all, 32 men over 60 years of age were active in the Service Detachment, including one who served in the Civil War.

In analyzing the situation it was decided that the Army and Navy had taken care of every possible contingency except riots and violence by disloyal persons and air raids from ships off the coast, and these were singled out as the field for the activities of the Veteran Corps. Plans were accordingly made for organization as an antiaircraft battery, a drill dummy gun was ordered, and a commission of three officers was sent to Europe to gain first-hand information about antiaircraft at the front and in the defense of cities. The Veteran Corps of Artillery of New York was the only non-Federalized state militia unit to be represented in France. Two dozen Lewis machine guns, hundreds of Krag rifles, stores of ammunition, clothing, equipment, etc., were purchased, and a training camp established at City Island—without expense to the State or Federal governments. Funds were raised by popular subscription and the troops at City Island not only were on no pay roll but paid their own expenses.

Before the antiaircraft equipment was available and before the other units of the newly formed "New York Guard," so named to differentiate it from the "New York National Guard" then in Federal service, could be whipped into shape a threat to the City's water supply was discovered and two batteries of the Veteran Corps were rushed into the 1st Provisional Regiment, New York Guard as Companies "A" and "B." This organization was put on sentry duty patrolling miles of muddy, torn land of the unfinished aqueduct, rather a different service from that which it had expected as an antiaircraft unit, but one necessary to the State. Of the 1438 enrollment a total of 689 saw aqueduct service, 270 later entered the Army and Navy of the United States, of whom 156 received commissions, 8 served in foreign forces, and when the regiment was broken up, 782 entered other New York Guard units, 121 receiving commissions. Of these last was formed the nucleus of the 9th Coast Artillery, now known as the 244th Coast Artillery Regiment, U. S. A., in whose armory the Corps now makes its headquarters.

TODAY the organization numbers well over 300, of whom the majority belong to the Society and over one hundred are in the uniformed Artillery Service Detachment with fife and drum field music. Some 25 are descended from original Revolutionary members, including the Colonel-Commandant, Brig. Gen. Chas. Elliot Warren, a grandson of Lt. Col. (later Major-Gen.) William Warren, who is a veteran of the Spanish-American, Mexican Border and World Wars, recipient of the United States Distinguished Service Medal and the Cross of the Legion of Honor of France, and other decorations.

The membership of this organization since its inception has been composed of some of the most influential men in the City of New York, men who have recognized and supported the chief purpose of this and kindred organizations, namely, the keeping alive of that spirit of patriotism upon which, in the future as in the past, must depend the country's hope of a ready response to the call to arms. In its present membership are about fifty men who have the right to wear the Eagle of that great military body, the Society of the Cincinnati. In its infancy the roster included Alexander Hamilton, Jr., and today contains such Regular Army names as Cols. U. S. Grant 3rd, and Edgar Hume, New York National Guard names as Generals Sherrill, Delafield, Daniels, Catlin, Falls, and Warren, and such names as Vanderbilt, Pell, Rhinelander, Van Rensselaer, Suydam, and Schermerhorn, which, in addition to the foregoing were prominent in little Old New York.

The Service Detachment today turns out as guard of honor to distinguished guests during patriotic exercises in the City, drills snappily and shoots accurately one night a week through the winter, and holds a summer training camp which of recent years has been officially recognized by the Federal Government and designated a Reserve Officers' Contact Camp with assignment of a regular Army officer as inspector-instructor.

At camp uniforms are worn, bugle calls are sounded, there are formations and lectures, and the day begins and ends with morning and evening gun at flag-raising and lowering, but there the resemblance to the average idea of a "hard-boiled" military outfit ceases. Off duty there is a casualness between officers and men that speaks of traditional comradeship dating back half a dozen generations. There are not sufficient grades to go around with the result that there are privates in the Corps who hold commissions ranging from 2nd lieutenant to colonel in the Organized Reserves.

There are no drills at camp; instead sports are encouraged and actively engaged in—from swimming to riding—golf to archery—but the real competition is on the range, where the only contention is who can make the greatest number of perfect scores with an assorted armament that resembles a gun lover's dream—for the Veteran Corps of Artillery today, as throughout its entire history, keeps its ordnance up-to-date.

Coldwork Method of Gun Construction

A Review and Discussion of Macrae's "Overstrain of Metals"

By T. C. Dickson*

A VOLUME conspicuous for conciseness and exceptional clearness in presentation, "Overstrain of Metals and its Application to the Auto-frettage Process of Cylinder and Gun Construction" shows a remarkably broad and lucid understanding by Colonel Macrae,[1] its author. The following questions are raised and differences in observed results are cited with a view to clarification.

Whatever may be the curve of stress-strain upon release of the pressure by which a tensile test specimen is cold-worked tensionally in a testing machine (FK, Fig. 13, page 17)[2] and its approximation in parallelism with the stress-strain line within the proportional limit of the specimen (OE, Fig. 13) the parallelism of the corresponding curves obtained with an open-end, single piece, hollow steel cylinder becomes less as the amount of permanent enlargement given to the diameter increases.

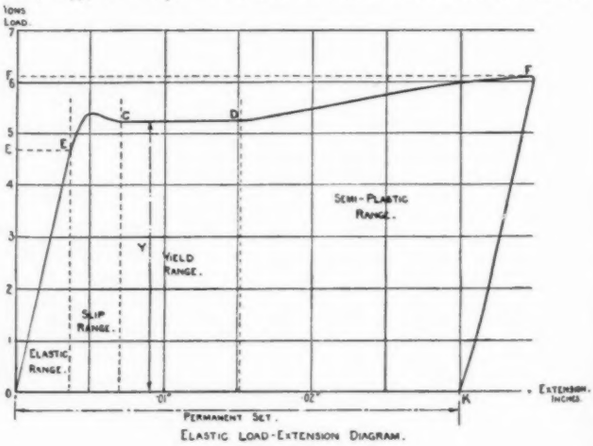
There will be used in this paper the unit strain per 10,000 lbs. per sq. in. pressure applied in the bore, measured experimentally with pressures within the elastic strength of the cylinder. Also there will be used the unit strain per 10,000 lbs. per sq. in. pressure applied in the bore obtained experimentally by measuring the changes in a given diameter that occur when the pressure applied in the bore for coldworking is increased and is subsequently reduced to zero (see XC Fig. 150, page 219). The ratio of the unit strain per 10,000 lbs. pressure after coldworking to the unit strain within the elastic strength for the same diameter averaged in 16 cylinders 1.29; the corresponding ratio after coldworking and soaking at 300° C. averaged 1.15. These records question that BX is approximately parallel to AO in Figs. 81 and 150.

While FK may be approximately parallel to EO, Fig. 13, for a solid cylindrical test specimen loaded tensionally in a testing machine, there are records which show no approximate parallelism for corresponding lines in curves plotted from experimental data obtained from open end, single piece hollow steel cylinders. The cylinders used were cold-worked to an enlargement of the diameter of the bore from 1.75 to 12.12 per cent. The average includes the ratios of unit strains measured on five different diameters of each of three cylinders.

The description on pages 29 to 33 of the effect of "auto-frettage," called herein "coldworking," seems plausible so long as there is an outer annulus of the cylinder that has not been coldworked. The explanation is not satisfying when the entire wall thickness has been coldworked and no originally elastic annulus remains.

If solid cylindrical test specimens are taken tangentially from the wall of a hollow steel cylinder and subjected to a tensile load in a testing machine and the data shown in Fig. 13, are taken, and if the remainder of the cylinder is subjected to an interior pressure and the changes in one or more diameters and in the length for various applied pressures, the maximum applied pressure being sufficient to permanently enlarge each diameter measured, are taken and plotted both for the building up and also for the release of pressure to zero, the resultant relationship between applied pressure and enlargement of each diameter will be that shown in Fig. 246 (page 368), when they are completed by line BX in Fig. 150, by releasing the pressure to zero.

The pressure-expansion curve, Fig. 150, is a right line from O to A, showing that the cylinder is elastic for any pressure not exceeding OA. As the pressure in the bore is increased from OA to OB, successive annuli, beginning with that forming the wall of the bore, will be stressed beyond the original proportional limit, that is "auto-fretted" or "cold-worked," and the load-expansion diagram will be a curve of the form shown, and apparently tangent to the right line at A. This pressure-expansion curve is similar in every respect to the pressure-exterior expansion curves shown in Figures 82, 153, 158, 165, 188, 191, 194, 195, 196, 201, 206, 210, 245, and 246. Not one of these curves shown in the book and not one of many similar curves available to the writer shows any similarity to the load-extension diagrams obtained from solid tensile test specimens loaded in a testing machine shown in Figures 13, 28, 114 to 131, 140, 141, 239, and 242.



ELASTIC LOAD-EXTENSION DIAGRAM.

Figure 13.

This lack of similarity between the load-extension diagrams of tensile test specimens and the pressure-expansion curves may be due to:

(a) The increment of pressure applied to hollow cylinders may not have been sufficiently small to disclose the presence of a "yield range," etc.

(b) The use of the results obtained from solid cylindrical test specimens subjected to a tensile load in a testing machine to predicate the corresponding results obtained from

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1. "The Overstrain of Metals and its Application to the Auto-frettage Process of Cylinder and Gun Construction," by Lieut. Col. A. E. Macrae, O. B. E., p.a.c., Royal Artillery, British Army, London: His Majesty's Stationery Office.

2. All graphs accompanying Colonel Dickson's review are reproduced from Colonel Macrae's book by special permission of the Controller of His Britannic Majesty's Stationery Office and of Colonel Macrae. References in this review are to the graphs as numbered and to the pages on which they appear in the book.—Ed.

a hollow cylinder subjected to an interior radial pressure may not be justified.

It is to be hoped the author will include in the next edition of his valuable book conclusive proof of the justification of the use made by him of this similarity, which appears to be the basis of the equations deduced.

When a solid cylindrical bar or test specimen is subjected to a tensile load in a testing machine the strains produced in any particle in the bar are represented by:

$$\text{Unit strain parallel to longitudinal axis} = \frac{p}{M}$$

$$\text{Unit tangential strain} = -\frac{1}{M} \times \frac{p}{3}$$

$$\text{Unit radial strain} = \frac{1}{M} \times \frac{p}{3}$$

In which M = modulus of elasticity.

p = total applied load divided by area of cross section of solid cylindrical bar. For a hollow steel cylinder with open ends subjected to an interior radial pressure let:

p = unit radial pressure.

t = unit tangential tension.

M = modulus of elasticity.

The unit strains produced in a particle within the walls of the cylinder by the pressure applied in the bore are represented by (see equations, page 12):

$$\text{Unit longitudinal strain parallel to axis of cylinders} = \frac{1}{M}\left\{\frac{p}{3} - \frac{t}{3}\right\}$$

$$\text{Unit tangential strain} = \frac{1}{M}\left\{t + \frac{p}{3}\right\}$$

$$\text{Unit radial strain} = -\frac{1}{M}\left\{p + \frac{t}{3}\right\}$$

These expressions appear to show the unit strains produced in a solid cylindrical bar subjected to a tensile load parallel to its longitudinal axis differ sufficiently from the unit strains produced in a hollow cylinder with open ends by a radial pressure applied in the bore, that questioning the accuracy of the basic use made in the text of data obtained from the former in predicting the unit strains in an entirely different geometrical shape appears justified in the absence of proof.

The gun formula shows the radial pressure is zero at the exterior surface of an open-ended hollow steel cylinder that is subjected to an interior pressure; the same formula shows the existence of a radial pressure at all radii less, even infinitesimally less, than the radi[illegible] of the exterior surface. The radial pressure would increa[illegible] through a radial thickness measured from the exterior surface equal to the diameter of a tangential tensile test specimen unless its diameter is infinitesimally small. The statement on page 27 ". . . where $P_3 = 0$, the stresses represented by S_0S_3 are those *equivalent* to tensile stresses applied to a test piece, and S_0 is greater than S_3" and the similar statements on pages 199 and 201, would appear to need further justification.

"Slip" and "yield" do occur in solid cylindrical test specimens, as shown in Fig. 28, page 30. What some call "creep" is possibly the "yield" shown. "Steps" have been found rarely within the proportional limit, but much more frequently in approximately the regions called by the author "slip range" and "yield range."

DR. H. H. LESTER, research physicist, has stated: "Rosenhain and others as early as 1900 observed evidences of slip in cold-worked metals. Tamman in 1914 proposed the

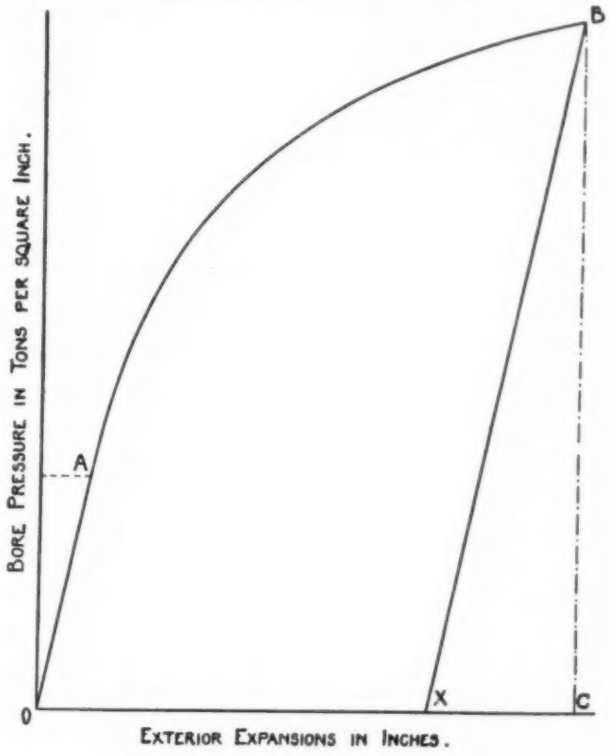

Figure 150.

theory that all plastic flow, that is all cold deformation, occurs by a series of slips of the metal along atomic planes. His theory has been amply verified by experiments in his own and other laboratories." Dr. Lester has observed that even below the elastic limit a large part of the deformation of the steel occurs by slips of the metal along atomic planes in the small crystals. There is no essential difference between the slips that occur in the elastic range and those that occur in the plastic range, except in point of magnitude, and certain effects in the metal due to the magnitude of the movements such as the causing of residual elastic strain.

The designer, maker and user of guns are not interested in "slip," "yield," "creep," "step," "slippage" and similar phenomena exhibited by the metal when in the form of solid cylindrical test specimens, but they are interested in the maximum pressure to which a given gun can be subjected repeatedly with safety. Whatever may be the various phenomena produced in steel during coldworking, the practical fact remains, as demonstrated by Colonel Macrae and by others, that single piece guns have been made by the coldworking process which, for the same dimensions and weight, are stronger than built-up guns. Whatever phenomena occur in the steel of which a hollow cylinder is made during coldworking, the effects are summed up by the maximum pressure applied in the bore, which effects are revealed

in the expansion under that pressure by the permanent enlargement produced, by the elastic recovery during release of the pressure to zero, by changes in the physical properties, and by the strain of tension left in the exterior part and the strain of compression left in the interior part of the wall. It would seem that these pertinent and governing data

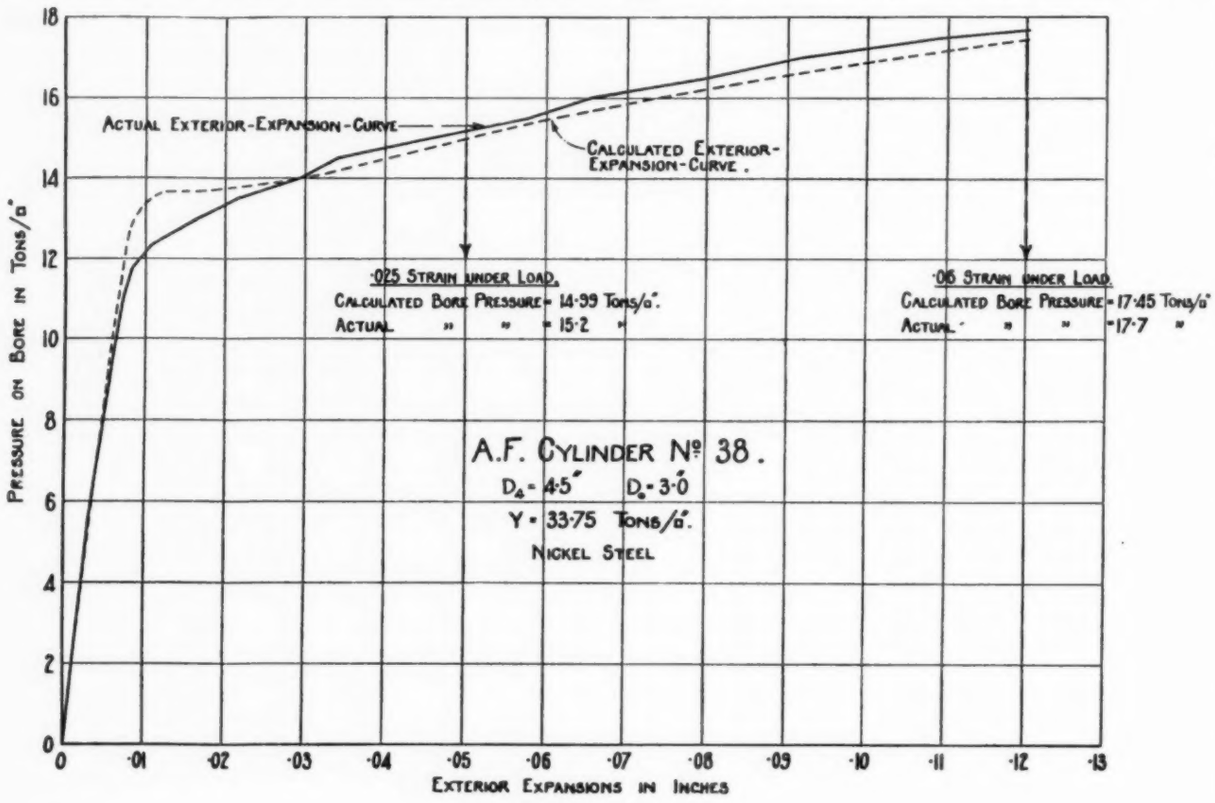

Figure 245.

exterior diameter is stated to occupy the annulus bounded by radii of 5.208 in. and 9.96 in. or about 53.4 per cent of the total area of cross-section and the constant tangential stress throughout this annulus is given as 19.7 tons. Carefully removed and measured strain rings, consecutive increases of bore diameter by machining and consecutive decreases in exterior diameter of coldworked steel hollow cylinders have failed to reveal an annulus of constant stress. The geometrical form of a one-piece, open ended, hollow cylinder would seem to make the tangential stress decrease by some regular law from the bore to the exterior surface. What would happen if a hollow cylinder was coldworked sufficiently to make the exterior diameter of the "yield zone" coincide with the exterior surface?

should control design and not molecular phenomena of the metal in solid cylindrical test specimens.

On pages 30 and 31 of Colonel Macrae's book are described the application of the phenomena observed in a solid cylindrical test specimen loaded tensionally in a testing machine to a hollow cylinder to which pressure is applied in the bore. In Fig. 29, 142, 151, etc., the stress is shown to be constant throughout the annulus of the gun, from D1 to D2, which corresponds to the "yield range" observed in the tensile test specimen. In the absence of definite proof of this assumption, it cannot be accepted for the following reasons:

1. No so-called "yield zone" nor its effect has been detected in numerous data obtained experimentally from hollow cylinders, including pressure expansion curves obtained simultaneously at five different diameters in the same cylinder.

2. It cannot be conceived how an annulus in a steel hollow cylinder that has been coldworked and is subsequently subjected to any less pressure in the bore can have a constant tangential stress throughout its radial thickness. Neither the radial pressure nor the tangential tension throughout "yield zone" are constant.

In a practical application on pages 232 to 237 of the formulae deduced applying to coldworked cylinders, the "yield zone" in a gun having a 3-inch bore and a 12-inch

ON page 39 it is stated that test specimens were taken longitudinally, see Fig. 36, to insure the same original physical constants. The reason given is unquestionable but there is, in the general case, a marked difference between the physical properties of longitudinal and tangential test specimens taken from the same forging. On page 65 it is stated "the value of the modulus of elasticity of a steel or metal is unaltered by 'overtension' or 'overcompression' even when these overstrains are followed by low temperature treatment." The average modulus after "overtension" is given on pages 40, 43 and 46 as practically the same as before coldworking. The stress-strain diagram of tangential test specimens taken tangent to the bore after coldworking are almost invariably curves, so neither the proportional limit nor the modulus can be ascertained with acceptable accuracy. Measured unit strains per 10,000 lbs. per sq. in. pressure produced at different radii, both for unit strains

within the elastic strength of the cylinder and for unit strains after enlarging the diameter of the bore from 1.75 to 10.22 per cent, substituted in equation 37, page 131, show the modulus of the cylinder after coldworking averages about 24 per cent less than the modulus of the cylinder before coldworking. Soaking coldworked cylinders at 300° C. makes the modulus of the cylinder practically identical with the value it had before coldworking.

Dean Earle B. Norris, Lieut. Col., Ord. Res., studied in 1926 available coldworking data and found by a different method that the modulus decreased as a function of the amount of coldworking and for 6 per cent bore enlargement was approximately 20,000,000 prior to soaking. The moduli after "overtension" given in the text are not understood unless those obtained from solid cylindrical test specimens taken longitudinally and subjected to only a tensile load in a testing machine are different from the moduli of a hollow cylinder obtained by subjecting it to an interior radial pressure. This marked discordance emphasizes the serious doubt raised of the use of results obtained from solid cylindrical test specimens to predict what will happen in a hollow cylinder.

The practical application to making guns by the coldworking process of the effect of the "overtension" of solid cylindrical test specimens when at a specified temperature (pages 36, 37, and 67 to 73), is not apparent. Giving guns a low temperature anneal after they have been coldworked is beneficial and the effects are ably described by Colonel Macrae.

The table of the maximum radial elastic resistance of monobloc steel cylinders given on page 120 is interesting. The conservatism of the formulae deduced by Colonel Macrae is illustrated by the following table:

important disagreements, such as the modulus after coldworking.

On page 134 the statement appears that the longitudinal strain is constant throughout the right cross-section of an open-ended hollow cylinder subjected to interior radial pressure. Does this not result from an assumption made in the deduction of formulae? Whatever may be the truth about the uniformity of the longitudinal strain within the elastic strength of a hollow cylinder, experimental data show, both during coldworking and after release of the coldworking pressure, that contraction and expansion parallel to the bore is a maximum in the surface of the latter and decreases through the wall thickness toward the exterior surface.

THE practical value of the coldworked process is well illustrated by its permitting guns to be provided when desirable with a removable liner described on pages 157 to 162. Coldworking a hollow cylinder of relatively low proportional limit increases its elastic strength and its elastic unit strain sufficiently to enable all the requirements for a liner having a relatively large diametral clearance between it and a tube of lower proportional limit to be fulfilled. It is regretted that Colonel Macrae did not give this feature of coldworking the prominence its utility deserves.

On pages 184, 185 and 305 it is stated that 2.5 per cent strain of the bore layer under load is considered the limit for the manufacture of guns, closed vessels, etc., and that the selection of this amount of "overtension" was made from consideration of "impact" qualities, which were practically unaltered after 2.5 per cent overtension, whereas after 6 to 7 per cent overtension they were lowered about 50 per cent. Other records show a reduction of as much as 50 per cent in individual tangential cylindrical test specimens

Cylinder No.	Bore and Exterior Diameters Inches	Average Tangential Elastic Limit After Heat Treatment	Experimentally Determined Elastic Strength of Cylinder	Calculated Elastic Strength of Cylinder		Ratio of U. S. to Col. Macrae Gun Formula Elastic Strength	Wall Ratio	Elastic Strength Computed by U. S. Gun Formula Exceeded Experimental Elastic Strength
				U. S. Gun Formula	Colonel Macrae Gun Formula			
1	3 x 4.5	75,250	25,000	25,654	20,903	1.2273	1.5	654
4	6 x 9	75,250	25,000	25,654	20,903	1.2273	1.5	654
7	8 x 12	74,350	25,000	25,346	20,653	1.2273	1.5	346
10	9.5 x 14.25	71,083	23,500	24,232	19,745	1.2273	1.5	732
2	3 x 6	75,250	36,000	37,625	28,220	1.3333	2	1,625
5	6 x 12	75,250	37,000	37,625	28,220	1.3333	2	625
8	8 x 16	74,083	36,500	37,042	27,782	1.3333	2	542
11	9.5 x 19	64,690	31,000	32,345	24,259	1.3333	2	1,345
3	3 x 9	75,250	47,000	47,526	42,104	1.421	3	526
6	6 x 18	64,900	44,000	40,990	33,444	1.421	3	3,010
9	8 x 24	70,750	43,200	44,685	31,445	1.421	3	1,485

Note: Pressure applied in bores of cylinders was increased by increments of 2,500 and 5,000 lbs. per sq. in.; the recorded elastic strengths may have been and probably were in some cases too low. The British & Coulomb formulae give nearly the same elastic strength of cylinders.

The adoption by Colonel Macrae of the shear instead of the maximum strain theory is interesting. The gun of less weight for equal elastic strength permitted by the maximum strain theory would seem to warrant the expense of tests that would definitely disprove the latter theory before adopting the shear theory.

The accuracy of the experimental determination of the elastic strength of the cylinders is not questioned, yet the elastic strengths determined in the two countries agree closely with the elastic strengths calculated with the formula each country uses. The ratio of the formulae shows that used by the United States permits a maximum pressure considerably higher than that used by Colonel Macrae. Such a marked difference in experimentally determined elastic strengths could be accounted for if the steel or the effects of forging or of heat treatment differed materially in the two countries. Such a difference would account for other

broken tensionally in a Charpy impact machine. This dangerous decrease was met by the insertion in specifications for gun forgings of a minimum Charpy impact value which would permit a reduction by coldworking of 50 per cent. Gun forging manufacturers of the United States have met this requirement and thereby have made possible in gun making the advantages that result from coldworking to 6 per cent enlargement of the bore diameter. The average reduction in Charpy in the last 16 guns coldworked and not soaked thereafter was 13.5 per cent and in the last 67 guns coldworked and soaked was 13.4 per cent. Only two of

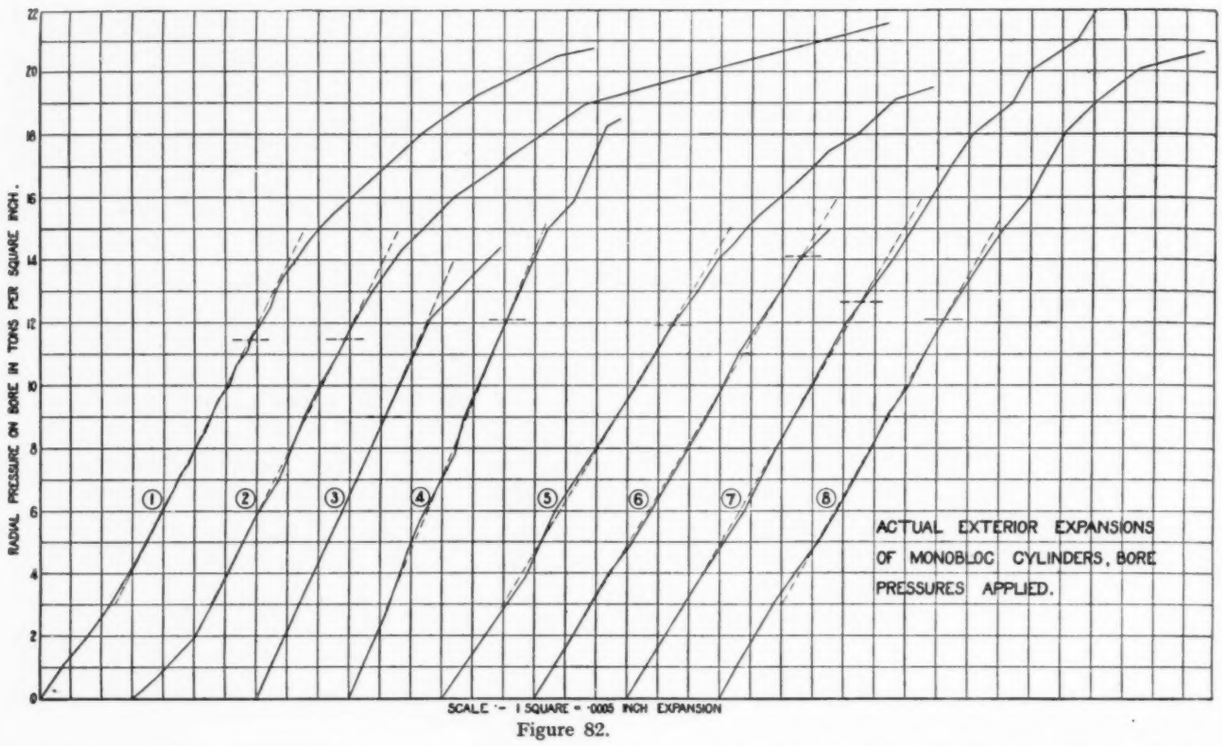

Figure 82.

these 83 guns had an individual Charpy value that was less than the minimum prescribed. The reduction in Charpy produced by coldworking to 6 per cent has been more than overcome by gun forging makers of the United States. Centrifugally cast guns are coldworked to an enlargement of the bore diameter of about 12 per cent and the average reduction in Charpy has been 23 per cent. Not a single individual Charpy test specimen taken from a centrifugally cast gun after coldworking has had a value as low as the minimum permitted after coldworking. In this connection it is deemed pertinent to state that Charpy impact test specimens are taken tangentially, are cylindrical, and are broken tensilely by impact. It is believed this test reveals more correctly the shock-resisting properties of the steel in a gun than does the Izod test.

ON pages 273, 276, and 280 it is stated tests showed that after coldworking and soaking cylinders were stable at slightly higher bore pressures than the maximum pressure applied during coldworking. On page 369 it is stated that coldworking a 3-inch by 4.5-inch cylinder to 6 per cent instead of 2.5 per cent increased the safe pressure from 15.2 to 17.6 tons per sq. in. or 15.7 per cent, and coldworking a 3-inch by 6-inch cylinder from 2.5 to 6 per cent increased the safe pressure from 27 to 30.5 tons per sq. in. or 13 per cent. These increases in safe working pressure are appreciable. Coldworking to about 6 per cent enlargement of the bore diameter enables a gun of equal strength and of less weight to be built than coldworking to 2.5 per cent permits, a decided advantage for mobile artillery.

An occasional forging has ruptured while being coldworked to 6 per cent. These ruptures occurred when the bore was permanently enlarged about 2.5 to 3 per cent. The fracture of each ruptured forging revealed inclusions within the wall and not visible from any exposed surface. Coldworking to 6 per cent bore enlargement eliminated speculation as to what might have occurred in service had these forgings been coldworked to only about 2.5 per cent.

After a gun is prepared for coldworking, the increase in time and cost involved in coldworking to about 6 per cent instead of to about 2.5 per cent permanent enlargement of the bore diameter is insignificant. The adoption of an average permanent enlargement of about 6 per cent permits a much larger percentum variation in the enlargement obtained throughout the entire length of the bore than when the permanent enlargement is as small as about 2.5 per cent. Experience shows individual steel forgings vary sufficiently in homogeneity to make exact uniformity in bore enlargement not easy of attainment.

SEVERAL statements, made on page 201, are used in the deduction of formulae for the calculation of pressures and stresses in a coldworked hollow single-piece cylinder. As some of these statements are basic, the omission of their proof makes the correctness of the formulae questionable. Gun formulae used by the Ordnance Department of the U. S. Army show that the unit strains at different diameters in the wall of the same single piece, open ended, hollow cylinder, when stressed within its proportional limit, vary as $\frac{2\,\frac{R^{12}}{R^2o} + 1}{3}$. Experimental data have verified this ratio within the elastic strength of cylinders and proved that the same ratio applies with equal correctness to ratios of unit strains per 10,000 lbs. per sq. in. applied pressure after coldworking, and also after coldworking and soaking. Experimental data show that a hollow one-piece, open-ended, steel cylinder, after it has been coldworked and soaked at about 300° C., behaves elastically within its then elastic strength similarly in every respect as did the same cylinder prior to being coldworked.

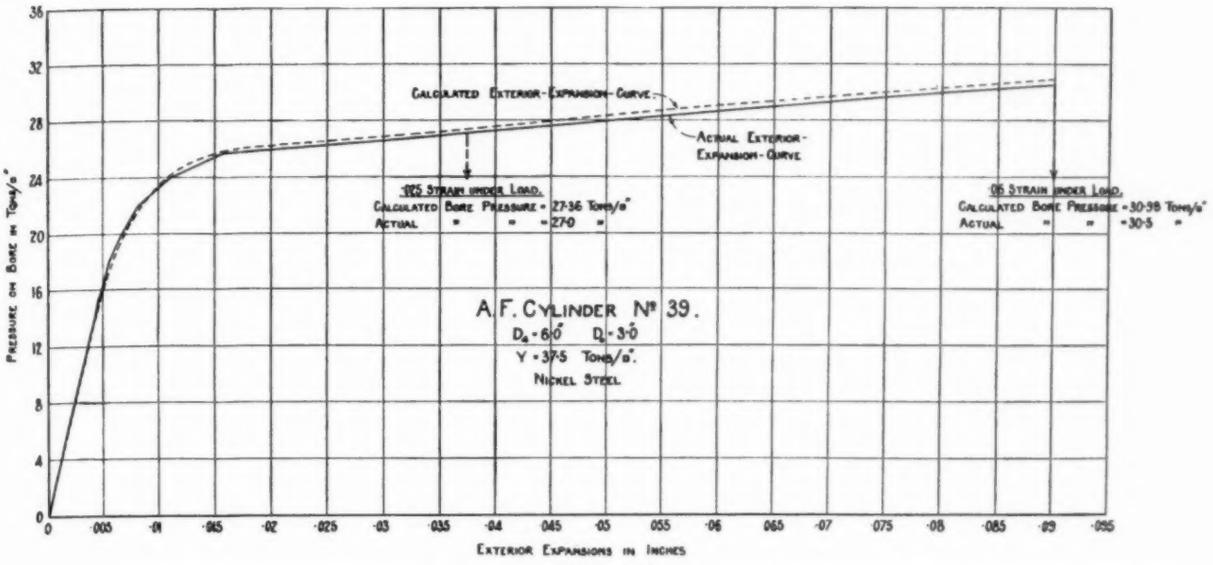
CALCULATED EXTERIOR-EXPANSION-CURVE.
ACTUAL EXTERIOR-EXPANSION-CURVE
·025 STRAIN UNDER LOAD.
CALCULATED BORE PRESSURE = 27·36 TONS/□"
ACTUAL " " = 27·0 "
·05 STRAIN UNDER LOAD.
CALCULATED BORE PRESSURE = 30·98 TONS/□"
ACTUAL " " = 30·5 "
A.F. CYLINDER Nº 39.
D₀ = 6·0" D₁ = 3·0"
Y = 37·5 TONS/□".
NICKEL STEEL
PRESSURE ON BORE IN TONS/□"
EXTERIOR EXPANSIONS IN INCHES
0 4 8 12 16 20 24 28 32 36
0 ·005 ·01 ·015 ·02 ·025 ·03 ·035 ·04 ·045 ·05 ·055 ·06 ·065 ·07 ·075 ·08 ·085 ·09 ·095

Figure 246.

Experimental data and gun formulae show that when an open ended, single piece, hollow steel cylinder is subjected to a bore pressure within its elastic strength:

(a) The length decreases. The decrease is maximum at the bore and decreases as the radius increases through the wall.

(b) The area of right cross-section increases.

(c) The volume of the cylinder increases.

These changes disappear upon release of the applied pressure; they are negligible in amount, but do occur.

Experimental data also show that, as the permanent enlargement of the bore and of successive diameters exterior to bore is increased during coldworking, all three of these changes occur, that the changes increase at an increasing rate, and that they do not disappear when the applied pressure is released. After such a cylinder has been coldworked and is subsequently stabilized by soaking, to use Colonel Macrae's apt designation, it behaves, with respect to changes in length, area of cross-section and volume, the same as before coldworking so long as the pressure applied in the bore does not exceed its then elastic strength.

THE following statements, made on page 201, and the uses made of them in the deduction of formulae, cannot be accepted in the absence of positive proof:

(a) The unit strains in the wall section of a cylinder stressed within the elastic limit vary inversely as the square of the diameters. Experimental data show a different relationship and this probably results from the increase produced in cross-sectional area and the decrease produced in length by coldworking. The divergence from the ratio given is quite small.

(b) Because the radial pressure at the exterior surface of the cylinder is zero, the expansion in that surface is equal to the product of the diameter of that surface and the unit strain obtained from a solid cylindrical test specimen tensionally loaded in a testing machine.

(c) The length of a cylinder, upon release of the pressure applied in the bore to coldwork it, is practically the same as the length before application of the bore pressure.

(d) The cross-sectional area of the cylinder, before the application of the coldworking pressure, must be equal to the area after that pressure is released; "that is, the 'residual' and the 'unauto-frettaged' areas are equal."

(e) That, for constant cross-sectional area, the unit expansions vary inversely as the squares of the diameters. This is correct. However, after coldworking the cross-sectional area differs from what it was before coldworking.

(f) Solid cylindrical tensile test specimen strains vary inversely as the squares of the diameters, "therefore the 'residual' unit expansions throughout the wall thickness agree with the residual test-piece strains."

These statements are used basically in the formulae deduced and as they disagree with a considerable quantity of painstakingly obtained experimental data, covering a wide range of cylinder sizes and amounts of coldworking, the use of the formulae should be held in abeyance until the author submits conclusive proof of the correctness of these statements and other data contradicting them are found to be erroneous. For only 2.5 per cent bore enlargement most of these differences would be very small and the neglecting of them may give sufficiently accurate results for practical purposes. For theoretically correct results and for practical purposes at about 6 per cent permanent enlargement of the bore diameter, the differences do not appear to be negligible.

THE section of Colonel Macrae's book on low temperature treatment, for which soaking is a shorter designation, is excellent and should be useful in general metallurgy. Other experimental work showed the maximum beneficial results were obtained by soaking hollow cylinders after coldworking to from 3 to 9 per cent enlargement of the diameter of the bore at about 325° C.; 300° C. was adopted as the beneficial effects decreased rapidly and at about 400° C. practically all effects of coldworking on the proportional limit disappeared.

The advantages of the coldworking process of making guns are given on page 344 with Colonel Macrae's pleasing lucidity. The methods of coldworking guns described require longer time, more preparation and machining than the container method. Water has been found satisfactory and cheap.

The chapter explaining the assemblage by coldworking

of one or more cylinders on another should be useful in industrial applications. To obtain a maximum of strength it would seem that the outer cylinder should be coldworked before assembling to the inner cylinder, that the diametral clearance can and should be sufficient to enable the inner cylinder to be inserted easily in the outer cylinder, that both cylinders should be coldworked as a unit, and that the assembly should be subsequently soaked.

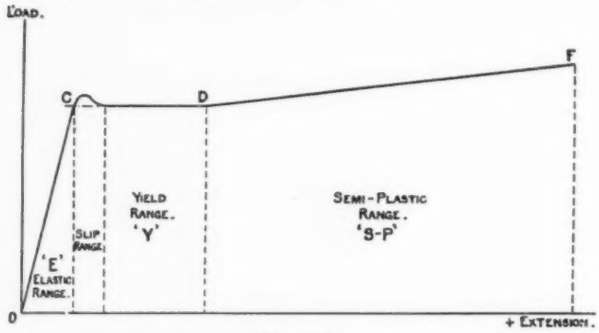

Figure 28.

Appendix I should have useful applications in addition to making liners in guns easily removable and replaceable when no longer accurate. Coldworking the liner to about 6 per cent enlargement of the diameter of its bore increases the elastic unit strain sufficiently to permit safely a surprisingly large diametral clearance between the exterior of the liner and its surrounding piece. The greater elastic unit strain per 10,000 lbs. per sq. in. pressure possessed by a coldworked but not subsequently soaked cylinder makes omission of soaking for removable liners advantageous.

Colonel Macrae's conservatism may be shocked by knowing that guns cast centrifugally are normally coldworked to about 12 per cent enlargement of the bore diameter and he may be interested in the following tensile and Charpy properties of a centrifugally cast gun, before and after it was coldworked to 40 per cent enlargement of the bore diameter. The gun was soaked at 300° C. after coldworking.

Location of Test Specimen	Proportional Limit Lbs. per sq. in.	Tensile Strength Lbs. per sq. in.	Elongation Per Cent	Reduction of Area Per Cent	Charpy ft. lbs.	
	After heat treatment and before cold working— 0".505 test specimen					
Breech	66,000	88,500	20.5	51.9	38.9	37.1
"	69,000	89,000	20.0	51.9	37.4	40.5
	0".357 test specimen					
Muzzle	78,000	97,000	20.7	59.2	32.6	39.5
"	76,000	95,000	24.3	62.0	36.6	35.3
	After coldworking 40 per cent and soaking 300°C.					
Section	106,000	130,000	10.0	49.2	27.9	29.7 29.8
from	110,000	130,000	13.0	49.2	31.7	27.4 25.9
center	110,000	126,000	13.0	49.2	31.2	27.1 25.3
of gun	116,000	126,000	14.0	46.2	31.4	29.0 25.2

Experimental data show that the beneficial effects of low temperature treatment after coldworking justify stronger emphasis thereon than given in the text. The statement on page 254 that alteration in strains during treatments of from 200° C. to 400° C. may be considered negligible may be true of solid cylindrical test specimens, but experiments with hollow cylinders subjected to various low temperatures after different amounts of coldworking show decidedly advantageous results when the temperature does not exceed about 325° C.

The following table shows the comparative elastic strength of a single piece not coldworked, a 2 layer built-up by shrinkage, and a single piece coldworked and soaked cylinder having the same bore and exterior diameter dimensions. The elastic strength of the single cylinder was computed from equation (24) page 128, using the yield point given for each cylinder.

Page	Cylinder No.	Wall Ratio	2 Layer Built-up. Tons per sq. in.	Single Cylinder After Heat treatment. Tons per sq. in.	Single Cylinder After Coldworked and Soaked. Tons per sq. in.	Initial Compression of Bore Given in Text. Tons per sq. in.	Percentum Enlargement of Bore Diameter.	Ratio of Elastic Strength After Coldworked and Soaked to that After Heat Treatment.
271–2	13	2	20.78	11.69	19.0	12.5	2.5	1.62
277	18	2	24.76	13.93	23.1	14.6	2.0	1.65
281	31	3	28.48	14.67	37.0	.....	2.5	2.52
287	27	3	25.03	12.9	32.5	.....	2.5	2.52
291–2	4	2.15	21.27	11.87	20.75	.....	.....	1.75
294–5	32	3.	30.81	15.86	38.0	19.5	.....	2.4
300–1	.....	2.3	28.42	15.33	32.0	19.5	2.5	2.08
309–13	.....	2.82	27.64	14.39	28.5	13.8	2.5	1.98

The foregoing table shows that the utilization of these advantages results in guns of at least equal strength. By using a sufficiently large permanent enlargement of the bore

Pressure-Exterior Expansion Curve.

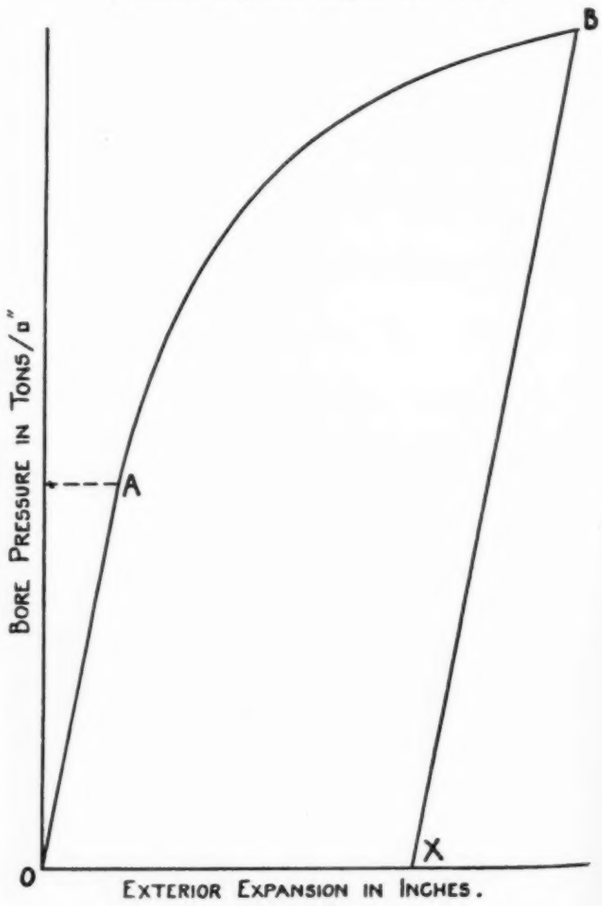

Figure 81.

diameter in coldworking greater strength will be obtained than shown by the table.

The text does not stress the increase in the proportional limit of the steel produced by coldworking and soaking, which is appreciable, averaging about 31 per cent for forgings. Nor does the text attempt to show how much of the increase in the elastic strength of an open-ended, single piece, hollow cylinder produced by coldworking and soaking results from the increase in the proportional limit of the steel and how much results from the residual compression produced at and near the bore.

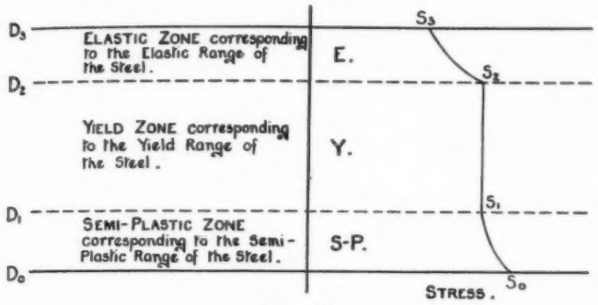
ELASTIC ZONE corresponding to the Elastic Range of the Steel.
E.
YIELD ZONE corresponding to the Yield Range of the Steel.
Y.
SEMI-PLASTIC ZONE corresponding to the Semi-Plastic Range of the Steel.
S-P.
STRESS.

Figure 29.

The use of the results obtained from solid cylindrical test specimens loaded in a testing machine for determining the residual compression at the bore of a hollow cylinder is seriously questionable. No experimental data are given in the text in verification of the approximate accuracy of the formulae deduced for computing the amount of this compression, and possibly for the reason that a method does not appear to have been devised by which such an experimental verification can be made with sufficient approximation to accuracy to be acceptable. The statement is made on page 222 that the method for determining the residual compression stresses in the steel near the bore is not strictly accurate but that experiments have shown the error is negligible for practical purposes. Until confirming experimental results that are convincing are made available, use of the formulae for computing the compression must be questionable.

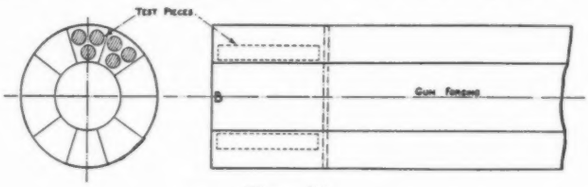

Figure 36.

THE "Overstrain of Metals" is a timely and valuable contribution to a new process developed primarily for making guns. The process should have useful applications industrially. Any one considering the use of the process will profit by understanding the principles so clearly and fully described and by the experimental data given, and should be assisted in practical uses of the process by the equipment and methods described and illustrated by Colonel Macrae. No other publication on the process known to the reviewer contains such useful and valuable information. It cannot be recommended that the equations deduced be used, unless verified experimentally for each application, until the author removes the doubts raised herein of the correctness of some of the basic assumptions made and the seriously questioned application with reasonable accuracy to an open ended hollow cylinder of the results obtained from a solid cylindrical test specimen loaded tensionally in a testing machine.

In the meantime, one wishing to use the process can safely apply a pressure in the bore that will permanently enlarge the diameter of the bore 6 per cent, then soak at 300° C., and depend upon the cylinder behaving elastically for any pressure not exceeding that applied to enlarge the bore, provided the steel has a Charpy of not less than 24 ft. lbs. If the Charpy is not less than 32 ft. lbs. the bore can be enlarged to at least 9 per cent with proportionate increase in the subsequent safe pressure. If metal is machined from either or both the exterior and interior surfaces after coldworking and soaking, no serious error will result from the use of Colonel Macrae's formulae for computing the final strength. The process should be carried out so as to permit the removal of as little metal from the bore as possible. If the cylinder has a relatively thin wall and if a number are to be coldworked, material advantages will result from coldworking in a container.

The Latest Type of Army Bombing Plane, a Low-wing Boeing Monoplane.

Possibilities of the Tank

Part IV: Leading up to August 8, 1918

By Fred. H. Wagner*

TO visualize the debacle of August 8, 1918, and to determine whether the tanks were or were not responsible for it (the former has been often asserted), it is necessary to examine into what occurred between the end of the German offensives of April, May and June and that date.

These three offensives extended the French line from the Oise to the Somme and the new Marne salient alone increased the length of the French line by some thirty miles, due to which the French reserves became greatly reduced and the center of gravity of what remained was approximately at Compiegne. As regards the British reserves, these had been pretty well used up in operations against the German advance on Amiens and on the Lys.

The first battle of the Marne in 1914 halted the waves of the German ocean of invasion when they threatened to break on Paris and end the war in the few months as promised by the German high command, and brought about the eventual stalemate. The second battle of the Marne in 1918 was the cause for these same waves receding and making the ebb tide which preceded the ever increasing rapidity with which these waves started to leave the shores which they had threatened to engulf four years before. German success was definitely halted and the great Allied counter offensive, which was to end the war, became a reality.

This second German offensive at the Marne was not, however, intended to be a last bid for victory, because Ludendorff still had in mind that the British had not recovered from the severe defeats of a few months before, and they would therefore fall easy prey to the decisive blow which he intended to strike in Flanders. The German command had no time to lose if final success was to be achieved, because it at last realized that a new element had entered the situation, and the advent of the ever-increasing tide of American troops, with their high morale as the result of defeating the Germans at Cantigny and near Chateau Thierry, was infusing a new spirit into the hard-pressed Allies.

The second battle of the Marne was to see the success of the "elastic defense in depth," first practiced in this war by the Germans on September 25, 1915, at Loos, or in the Champagne offensive, and which had been applied by Hannibal against the Romans at Cannæ. This elastic defense was, in this case, assisted by the German command having failed to create a surprise attack, because a raid on the German trenches on the night before the battle opened had revealed preparations for the coming attack.

This "elastic defense" was due to the cool brain of Pétain, who felt it necessary to economize human lives and not to expend them so lavishly as had been the practice by both Joffre and Nivelle. It is related that Pétain had a long argument of several days with Gouraud, who was to execute the orders, before he could persuade the latter to adopt the measure.

Pétain was convinced that a policy of waiting until the American troops were in such force as to off-set the four years of drain which the Allies had suffered would pay in the end, and he exercised all his powers of persuasion to bring this about. While Foch was planning an offensive against the Germans at Soissons he learned that the latter contemplated an advance near Rheims; Foch's usual policy of *Attaquez* consequently again came to the fore with the idea of anticipating the German effort by an attack on July 12. Fortunately, the French troops were not prepared for an attack on that day, and this agreed completely with Pétain's policy of first attempting to halt the offensive and to then strike quickly when the enemy had entangled himself in a position which would indicate a successful issue to the Allies.

Allied success at the Marne was, however, greatly assisted by the German withdrawal on July 16 of air and artillery forces for use on the Flanders front, where the "final offensive" was to take place, and Ludendorff, after having completed his plans for this Marne offensive, had taken himself off to Tournai.

THE Germans had forty-seven divisions in the new Marne salient and these, because of the German failure to include Compiegne in either the Amiens or the Marne salient, were dependent for supplies on a single railroad line between Laon and Soissons, a line which was sadly deficient for the purpose. If it were possible for the Germans to capture Rheims additional transport facilities would be established through the trunk line to Mezieres. A direct offensive against Rheims was, however, abandoned for the time and the German plans contemplated a great offensive against Chalons, leaving Rheims until after this had resulted favorably.

Again, if it were possible to capture Compiegne the trunk line from there to Liege would solve the pressing difficulty. In addition to this, the German command was under the impression that a move against Compiegne would lead the Allies to believe that an advance on Paris was intended; this in turn would cause the French to hold their reserves on the west of the Marne salient, or at a point where their quick availability for moving east of Chateau-Thierry—when the German offensive toward Chalons should be launched—would be impossible.

These considerations caused the German command to decide on the reduction of Compiegne which, if successful, would permit not only of a direct supply from Liege to the salient, but would also provide increased facilities for transfer of troops between the two salients of Amiens and the Marne. The Allied command, however, judged that the German reserves were not exhausted, and that if an advance on Paris was contemplated it would be astride the railroad line of Liege-Compiegne.

It was at this time that General Pershing rightly pointed out that communications for the German troops located in the Marne salient must pass through Soissons, and since this

*Consulting Engineer. The Bartlett Hayward Company, Baltimore, Md. Colonel, Ordnance Reserve, U. S. Army.

point was not far removed from the edge of the salient, he was of the opinion that it could be captured. General Pershing's request that he undertake this action with American troops was not granted at the time, although General Foch agreed with the opinion, but he was convinced that the single line through Soissons was insufficient for supplying the Germans in the Marne salient and, should the Germans capture Compiegne, Soissons would be protected and the main line Liege-Compiegne would be opened to them. This led Foch to the conviction that Compiegne was the strategical area which appeared most sensitive and, since this town was also necessary to the defense of Paris, he determined to hold the mass of his reserves at Compiegne and to remain on the defensive.

The Germans, preceded by *intense artillery* and *gas preparation,* attacked at 4:30 A. M. on June 9, their thirteen divisions covering a line of twenty miles, or from the Oise to near Montdidier. It is reported that asphyxiating gas was used in such quantity that the air became befogged. The attack failed on the east and west flanks, but it passed over and caused complete disorganization of the French artillery system in the center. On June 10 they were more successful, and the French fell back to Molin-sous-Touvent-Bailly. General Fayolle ordered General Mangin to counter-attack, and at 11:00 A. M. on June 10 this attack was launched without any artillery preparation, but *supported by all the heavy and light artillery available,* the line advancing with *160 tanks.* This counter-attack stopped the German advance in this direction on June 13.

This successful defense of Compiegne, coming after the Germans had almost brought the Allied line to the breaking point in the three offensives of April, May and June, caused quite a lowering of the German morale; while success raised the morale of the Allies from its depths, the German soldier began to suspect the continued ability of his leaders to lead him to the promised final victory. Another result of this Allied victory was to cause the German divisions in the Marne salient to depend to a large extent on animal transportation for supplies, and they lacked gasoline to such extent that truck transportation was available only in extreme emergency.

THE German command was still convinced that the capture of Chalons and Epernay would also give them Rheims. It was also expected that this would compel the French to evacuate Verdun and thus give an excellent opportunity to penetrate the French line. Should this penetration occur, he would fold back the left flank of the broken line onto the eastern fortified positions, while the right flank would be rolled back on the French left wing. The German command consequently planned the Chalons offensive with the III and I Armies in an attack to the east of Rheims, while the VII Army was to attack on the west of the city, the intention being that the inner flanks should meet near Epernay, thus enveloping Rheims, after which the entire force would attack in the direction of Chalons. This offensive was to be directed by the German Crown Prince.

The attack was to be launched at 4:30 A. M. on July 15, but, in order not to arouse any suspicion in the minds of the French, the Germans made no demonstrations on other parts of the line, but, as stated above, a raid the night before had informed the French of what was impending. This attack required that the III and I German Armies should break through a deep defensive zone dug into the chalk terrain, while the VII Army was confronted with a river which it would have to cross in the face of the enemy in order to advance toward Epernay. The German troops on the Champagne-Marne front consisted of eighty-five divisions, or fifteen divisions more than the force available to the Allies on this front.

Foch rightly judged that the Germans would not voluntarily give up the initiative, but would again launch an offensive either in the Champagne or in Flanders. He did not think, however, that the time was ripe to grasp the initiative himself, consequently he awaited the German offensive in his defensive positions. Foch also arranged with Haig for the rapid transfer of either British troops to the French sector, or French troops to the British line, accumulating a strategic reserve near Compiegne in the meantime.

IT was Foch's opinion that this next offensive would practically exhaust the German reserves on this front, after which the time for seizing an offensive initiative would be his; in view of this, and as stated above, Pétain prepared the defense in two positions, the first battle position to be held lightly by outposts only, these to fall back on the second position or "position of resistance." When the initiative had once passed into his hands Foch would adopt Pershing's plan of an attack on Soissons from Compiegne.

The Allied forces between the Oise and the Argonne consisted of fifty-seven French, four British, seven American and two Italian divisions, of which twenty-seven divisions were to engage in a counter-offensive against the western face of the German salient. The Allied plans also included the retaking of control over the Amiens-Paris railroad by the British.

The German offensive came off on time on July 15; nearly all the available reserves had been assembled and large amounts of supplies as well as an almost unheard of amount of artillery had been collected in secrecy, all movements having been made at night. This offensive against Chalons was expected to compel the French to sue for a separate peace.

Instead of two positions, the French Fourth Army took up three positions, or the "first battle position," not held in great force; the "intermediate position," or where the first real resistance was to be offered, and the "second battle position," which was to be maintained at any cost. On July 14 General Gouraud, commanding this French Fourth Army, ordered his *artillery* to lay down counter-preparation fire on the German assault units, while all the components of the army were ordered to their battle positions before hostilities began.

Artillery preparation of unheard of intensity, accompanied by gas, burst from the German lines to the east of Rheims at midnight, July 14-15. The *French artillery* with its counter-preparation surprised and caused serious damage to the III and I German assault armies before midnight, but in spite of this the assault was launched on time. Upon the advance of the assaulting columns the Allied outposts were withdrawn to the intermediate and second battle positions, while the German fire and infantry attack were both directed against the first battle position. This, however, was a useless blow, since the position was not occupied in any great strength.

The French and American *artillery* were now in position to mow down the attacking forces as they neared the first

position and as they advanced toward the second. The American infantry, in the intermediate position, picked off their men with rifle shots. The French and American *fire was so great* that the assault was stopped at the intermediate position at 7:00 A. M. along the entire front. Due to exceedingly heavy losses, Hindenburg abandoned the operation east of Rheims and resumed siege conditions but he hoped his VII Army would effect the capture of Rheims and thus permit him to retain the initiative.

On the west of Rheims the railroad line to Chalons was under German artillery interdiction fire, hence supplies to Rheims were available only over the small line from Epernay which crossed the Heights of Rheims; a distance of only ten miles lay between the east face of the Marne salient and this most important stretch of rails. The same care had, however, been accorded the defense of the Heights of Rheims from the west. After cutting the railroad, it was, as stated above, the German plan to capture Epernay and then join with the forces on the east for the advance toward Chalons, the expectation being that Rheims would in the meantime fall into their hands.

It will be remembered that this VII German Army was to cross the Marne which, flowing from Chalons past Epernay, was the southern boundary of the Marne salient from Chatillon-sur-Marne to Chateau Thierry. The river here is about 250 feet wide and 13 feet deep, while the banks are between 3 and 6 feet high; both sides of the river are commanded by flanking bluffs about 550 feet high, while the terrain is wooded.

TEN German divisions were assigned to the operation to be conducted south of the river, but since the stream ran along only a portion of the line between the opposing forces, the 6th French Army defending the river crossings treated it as a major obstacle and established a defense at the river line. Bridges no longer existed, but the forests north of the river presented excellent concealment to preparations for crossing, and there were quite a number of routes from the north which led to points where the launching of boats and the building of bridges were practicable.

The front held by the Allies along the river also was organized in two positions, the first of which was held by combat divisions, and the second, which was some distance to the rear along the reverse slopes of the hills, was held by general reserves. These positions were not completely organized when the German attack was launched on July 15, but General Dickman had succeeded in perfecting his defenses, the American 3rd Division sector, sufficiently to enable the division to occupy them and conduct a coördinated defense.

The first position consisted of an outpost line of observation and one of resistance, the former being along the river and held by a small number of riflemen in pits, supported by machine guns in emplacements. Close behind this line, or along the Paris-Epernay railroad, lay the outpost resistance line, termed the "railroad line," held by quite a strong force which could develop considerable fire. The main line of resistance was established on the forward slopes of the hills south of the river and supported by a system of strong points; this line was to be held in case of an attack. This was termed the "aqueduct line." Behind this was the army reserve line, known as the "wood line," which followed the crest of the hills to the south.

The mission of the 3rd Division was to prevent a river crossing, but should a crossing be effected the enemy was to be counter-attacked and driven back. The *machine guns* were grouped in the center of the division sector, also in front of the reserve line, while the *division artillery* and *supporting artillery* were grouped on the reserve line of the first position, on the army line, and between the two lines. The *guns* were laid to cover the river and its northern bank with a heavy barrage in the division sector, as well as to drop a barrage in front of the line of resistance south of the river.

All troops were ordered into their fighting positions before the attack began; a *gas-shell attack* was delivered on the German positions at 8:00 P. M. on July 14, while a *general counter-preparation fire* was ordered for 11:30 P. M.

THE crossing of the river by the VII German Army, covered by *artillery preparation* from 500 batteries was attempted on July 15. Under cover of this fire, aided by a dense fog and smoke screen, the Germans from east of Gland, to the east of Dormans, crossed in boats and on pontoon bridges. They were met by the rifles and hand grenades of the 3rd Division outpost, many of the boats being sunk. The enemy did, however, manage to cross and capture the Paris-Epernay railroad, from which he was to advance on Epernay.

As the French and American resistance developed the advance slowed down, and the American troops counter-attacked and drove the enemy from in front of their sector.

Hindenburg, recognizing his defeat east of Rheims, had stopped the operation on the 16th, but, as stated above, he still had hopes that his VII Army could capture Rheims, and although this VII Army could no longer join hands with the I Army at Epernay, the VII was ordered to cut railroad communications between Rheims and Epernay by the capture of the latter, but if this could not be accomplished traffic on this small railroad was to be interrupted at all costs. Every effort was made by the VII Army on July 16 and 17 to push the ten divisions, which were now south of the river, to Epernay. These efforts were, however, stopped on the night of the 17th by counter-attacks.

Without artillery support, with their bridges over the river *under constant fire* and *aërial bombing,* those divisions were unable to maintain their positions, consequently they were ordered to retreat across the Marne on the night of July 19-20.

The boundary of the salient, after the German offensive of July 15 had been stopped, is shown on the accompanying Marne map (Fig. 1). The boundary passes from Fontenoy to Faverolles, Belleau, Chateau-Thierry, Gland, St. Agnan, Comblizy, Oeuilly, Pourcy, Vrigny, and Betheny. The base of this salient from Fontenoy to Betheny was approximately forty miles, while its depth was twenty-five miles.

The result of this offensive not only failed to improve the supply situation in the salient, but it actually made it worse and, in consequence, an attempt was made to construct a railroad from the north of to the west of Rheims. This work was pushed with all possible speed, but it was not completed by the time the Germans were compelled to defend the salient against the Allied counter-offensive.

BOTH Hindenburg and the German government had confidently expected that this offensive of July 15 would decisively defeat France but this was not to be. Conse-

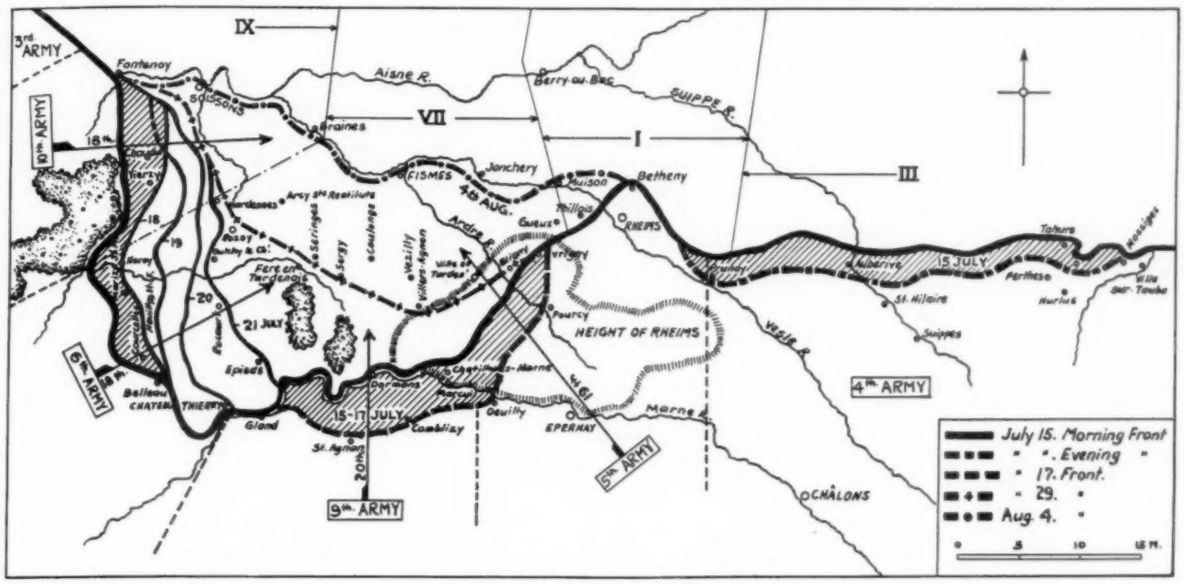

Fig. 1. Second Battle of the Marne, 1918.

quently Hindenburg treated this offensive as a diversion and turned again to his final great offensive planned against the British in Flanders. This operation now required expediting, consequently the transfer of artillery, airplanes and troops was ordered forward immediately, and on the 16th this movement was progressing favorably. On the 17th Ludendorff, who had been sent north, was conferring with the Bavarian Crown Prince about the necessary plans for this final effort, and Hindenburg, on the night of the 17th, relinquished the initiative in the Marne salient.

July 15th had been presented to the German soldiers as the date on which their final victory would begin; they were told that the German Crown Prince had collected nearly a million men for this drive. The violence of the artillery bombardment and the mass of preparation had greatly impressed them, but when action ceased they were informed that the objectives had not as yet been reached, but they had no knowledge that the drive had been completely stopped. Hindenburg was under the impression that Foch had thrown all his available reserves into the line in order to stop the drive, and reports had reached him that the French were organizing a *tank offensive* south of Compiegne. This report, however, seemed to have but little effect on the German soldier, because those within the salient, and not directly in the line, went into the surrounding fields and began to *harvest the wheat crop*.

The morale of the Allies began to recover after the battle of Cantigny from the low depths of 1917, this change having been brought about by evidence that the American troops could more than hold their own against the supposed superiority of the Germans. It was at this time that the Allies began to become grateful for General Pershing's insistence that the American troops be trained for open warfare and that they were instilled with the will to succeed.

When Hindenburg decided on the 16th to stop the offensive of his I and III Armies and to consolidate his position he, as stated before, doggedly retained the plan of capturing Rheims for the purpose of improving his supply situation and which was necessary should he retain the initiative. The fate of Rheims was suspended on a very thin thread since, on July 16, the German VII Army was only six miles distant from Epernay and it almost reached the Rheims-Epernay railroad north of the Marne. The Rheims-Chalons railroad was under the fire of German guns near Rheims, consequently the only communication with this city was by the much disputed line from Epernay.

A temporary suspension of the attempt on Rheims was, however, ordered on July 17, or after Hindenburg had become impressed with the force developed in the French local counter-attack from the Heights of Rheims. He had the feeling that thorough preparation would be necessary before he could again attack, but under the circumstances this would require several days.

GENERAL FOCH now reverted to General Pershing's plan against Soissons, or a drive between the Aisne and the Ourcq rivers, this action to be carried out by the French 10th Army with the 6th Army in support, the general direction of the former being on Braisne and of the latter on Fere-en-Tardenois, which, if successful, would cut the line of communication of the German troops in the Marne salient.

At the same time an attack was to be delivered by the French 5th Army on the southern face in the direction of Fismes, thus coöperating with the 10th Army on the west. The plan also called for the 4th Army to stand and defend its sector should the Germans attack with the purpose of capturing Rheims. The necessary orders were sent out on July 17 and, as explained in a previous article, all movements and preparations were bound up with the utmost secrecy; *no preparatory bombardment* was to take place prior to the attack of the 10th Army in order not to give the enemy any idea of the French intention.

The French strength on the western face of the salient was now far in excess of the German, the 10th Army front being composed of twenty-three first-class divisions, thirteen of these being in the front line while, as stated previously, the German line was defended by eleven undermanned divisions. The assignment of *470 batteries* to the 10th and *230 batteries* to the 6th Army *ensured rapid and extensive*

destruction as well as *interdiction and concentration fire.* The 10th Army was assigned *375 light tanks* while the 6th Army was provided with *170 tanks,* their objective being the *destruction of obstacles, machine-gun nests, transportation of infantrymen and machine-gun crews* required to emplace machine guns in the rear of the enemy front lines *after the infantry had broken through.* Control of the air was ensured by forty air squadrons attached to the 10th Army, while twenty-eight squadrons were attached to the 6th Army.

The attack progressed as planned, the 10th and 6th Armies *effecting a complete strategical and tactical surprise* on the western face of the salient. The German soldiers not on duty in the front line were, as stated above, out in the fields harvesting the wheat crop, and to these the appearance of the tanks produced a terrifying effect, since they were not expected. *The tanks which went through the broken line destroyed machine-gun nests and broke-up enemy rallying groups, while others established strong points and machine gun nests* in advance of the following troops. The tanks did just what they were intended for. By night on July 18 the front of the 10th and 6th Armies was on the line Fontenoy-Chaudun-Vierzy-Noroy-Belleau.

The battle continued, and between July 19 and 21 the 10th Army had reached the eastern slope of the Soissons plateau; the 6th Army had cleared the north banks of the Marne as far as Jaulgonne. *Owing to the failure of tanks to arrive,* the 9th Army was delayed, but it attacked on the 20th and cleared the south bank of the Marne. But since all bridges had been destroyed it could not cross the river until new ones had been prepared. On July 19 the 5th Army launched an attack from the Heights of Rheims in the direction of Fismes.

The German Crown Prince fought a fight of desperation to save troops attacked on three sides and to prevent the loss of material and his own railroad at Soissons. All the reserves at hand, as well as those taken from Noyon and Champagne, were thrown into the line, while the Bavarian Crown Prince aided his august brother by sending him six divisions, followed by three more from von Gallwitz, but in this case all was of no avail, and by July 29 the salient had been reduced to the line Bligny-Villers Agnon-Sergy-Rozoy to west of Soissons.

No rest was to be allowed the harassed enemy, and another blow was launched by the 10th Army when, on August 2, it advanced in the direction of the Arcy-Ste. Restitue plateau; the Crise river was crossed during the night; the remainder of the line also advanced and by August 4 the entire salient was cleared of the enemy to the siege line established on the Vesle river. All other plans were abandoned for the time by Hindenburg, but he gathered reserves from wherever any could be found and sent them to stop the counter-offensive southwest of Soissons. Unfortunately for him, however, the high ground which had been captured by the Allies enabled the placing of *interdiction fire* on the railroad net near Soissons, consequently all troops moving forward to the battle ground were compelled to detrain, and all material had to be unloaded near Laon, the troops going forward from there by forced marches, but the Marne salient was evacuated.

Hindenburg could expect no further material assistance from the other fronts, and the morale of the German troops suffered another drop of several degrees, some of the units *shirking their duty* at the front, and *others mutinied.* The situation was pronounced *very grave* by *Ludendorff.* The *discouragement* of the German troops was shared by the people at home as well as by the government. We have the evidence of even the German Chancellor, von Hertling, who said "At the beginning of July, 1918, I was convinced, I confess, that before the first of September our adversaries would send us peace proposals * * *. We expected grave events in Paris for the end of July. (That was on the 15th.) *On the 18th, even the most optimistic among us understood that all was lost.* The history of the world was played out in three days."

Remember this was said before August 8, or before the day for which the tank enthusiasts claim Ludendorff's "black

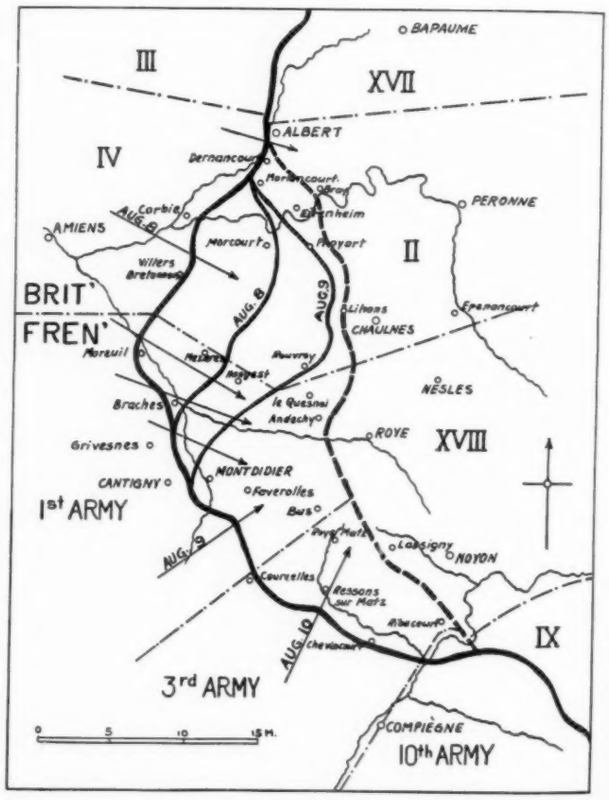

Fig. 2. The Amiens Salient, 1918.

day" exclamation as being due to the effect of their particular weapon. You may read in my previous articles what happened to the tanks during the clearing of the Marne salient.

SINCE there was now no fear of German threats against Paris, the French morale began to rise by leaps, and enthusiasm for a continuance of the war to a finish increased. The British no longer feared for the channel ports, and their principal desire now was to drive the Germans further away. There had been no drop in American morale, but success increased a desire to continue and make an end of the war.

As stated before, Hindenburg knew the initiative had passed out of his hands, and due to the fact that nearly all his reserves were being assembled in Flanders for the "peace drive," he no longer had the strength to recover it within a reasonable time. Consequently he decided to give his troops

time to recover with the hope that the Allies would make a mistake of which he could take advantage and again seize the initiative.

In the meantime Foch decided to continue the offensive, surprise being the basis of all his calculations. The next blow was to be delivered where it was least expected, or an offensive which was to free the Paris-Amiens railroad route by reducing the Amiens salient, while exploitation of the offensive which had reduced the Marne salient continued.

Unfortunately for the Germans, they had prepared no specific plan for defending the Amiens salient. The loss of the initiative did not sit well in the German mind filled with the glamor of victory. They seemed to be *actually stunned* by the Marne results. The German soldier was, however, told that defensive warfare had been resumed by the Allies, but their lines in the Amiens salient lacked proper intrenchment or other preparations for a proper defense.

Foch ordered a diversion in Flanders to attract the attention of the enemy, consequently Haig placed Canadian troops on the Mount Kemmel front. Casualty clearing stations were established where they could be seen by the enemy, who also identified the Canadians; the First Army area was alive with wireless activity; *tanks* were concentrated in the St. Pol area, while combined *infantry* and *tank* maneuvers were maintained for German observation when visibility made this possible. *The Germans were lulled to sleep as regards the real offensive.*

AT 4:20 A. M. on August 8 the British Fourth Army, without any prior artillery preparation, but *accompanied by 420 tanks,* and supported by one of the *most intensive artillery concentrations* seen during the entire war, advanced to the attack. The *artillery completely crushed* that of the enemy; what trenches had existed were *entirely obliterated.* From 4:20 to 5:00 A. M. the *artillery* of the 1st French Army prepared the road for the French advance, the British attacking north of the line: Amiens-Roye and the French south of this line (see map of Amiens salient, Fig. 2). The attack was a *complete surprise;* the German lines were battered to pieces and penetrated, and the enemy soon fell back.

Light tanks and *armored cars* accompanied the mobile forces as they passed through the broken line, and when night came the infantry had advanced some seven miles. The mobile force continued to advance during the night, telephone communication between German headquarters and the troops was cut; several division headquarters were captured by surprise. The *air service* was busy all night attacking and bombing. It did not take long before rumors spread in the German line that Allied *tanks* and *cavalry* were already in their rear; this part of the line immediately retreated with such haste that a rout was barely avoided. The dumps were blown up and everything that could not be readily carried away was abandoned. German troops, due to the surprise, were lacking for counter-attacks, and the guns required for such attacks were either captured or destroyed by the *Allied artillery.*

This was the "black day." The Germans now no longer had any confidence in their commanders, entire bodies of soldiers made haste to surrender to isolated squadrons of Allies, and even to single Allied soldiers. Ludendorff requested that he be relieved; he also requested a conference with his government. He reported that peace could no longer be forced on the Allies, and that a defensive policy would never win peace, consequently he recommended that diplomacy be reverted to for terminating the war.

It is not my intention to attempt the writing of a history of the World War, and I have cited the happenings at the Marne and the Amiens salients only in an endeavor to explain how these battles were won by the Allies. You will note that *complete surprise* with concentrated devastating *artillery fire* preceded any attack by *tanks.* Here at last, however, the tanks came into their own, when they accompanied a mobile force which could penetrate the enemy line after the *artillery* had smashed all defenses, put out of action all enemy counter batteries, and after the *infantry* had breached the line. The *tanks* accomplished the character of work they were intended for within the German lines, but their success here does not herald them as the main component of any army of the future. The *guns and surprise* prepared the way for whatever the *tanks* accomplished; what happened to the tanks may be seen in my first article.

"We were not defeated by the genius of General Foch, but by General Tank"? Vale!

(To be concluded in the March-April, 1932, issue.)

A Medium Tank Passing Over a New Type Pontoon Bridge, a Development of the Corps of Engineers, U. S. Army.

The Application of Welding to Armament

Rock Island Arsenal, A Center of Progress in the Art

By John W. Slattery* and Walter W. Ransom**

ONE of the outstanding memories of a visit to Chicago, is the striking beauty of the Merchandise Mart. At night when this building, the world's largest, is floodlighted, no one can fail to be impressed with the magnificence of outline and its reflection in the Chicago River. Contemplating this structure, representing fourteen stories of field-welded steel, one is inclined to marvel that the arc-welding process has developed so rapidly in the realms of building construction.

The application of electric arc welding to reinforce corroded or overstressed structural members of bridges is again brought home to many who annually visit the Aberdeen Proving Ground in crossing the famous old toll bridge over the Susquehanna River at Havre de Grace, Maryland. This bridge has had an additional floor system welded into the old trusses, above the existing floor, to convert the structure into a double-deck highway bridge for heavy automobile traffic. This bridge, consisting of several spans, is approximately three thousand feet in length. It is understood that 1500 tons of steel were added by welding, and no rivets were used.

Such noteworthy examples of the application of welding to construction, and the apparent confidence shown by engineers in civilian pursuits in metallic arc welding, may well make ordnance engineers consider its applicability to ordnance matériel.

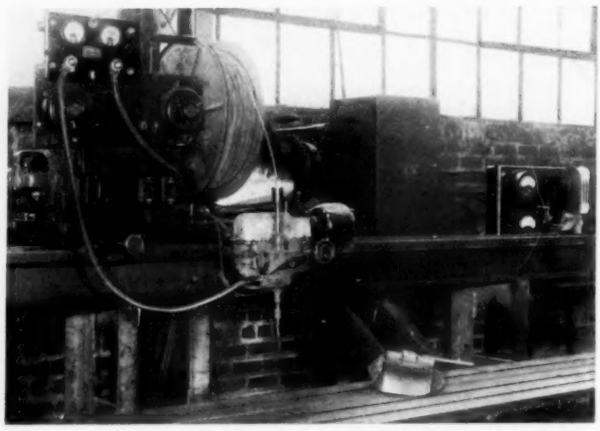

Fig. 1. Automatic Welding Machine at Rock Island Arsenal.

ORIGINALLY selected as a Western Armory (as a result of a study directed by Congress in 1835), Rock Island Arsenal, owing to a centralization of manufacturing interests in the well-known manufacturing area where raw materials may be had in abundance without excessively long and expensive railroad hauls, is today located in the veritable center of this immense Middle West, within a convenient distance of Chicago. Rock Island Arsenal, embracing as it does an entire island of nearly a thousand acres, is most fortunately located to reap the fullest advantages from the nine-foot channel development in the Mississippi River. It is confidently expected that the completion of these inland waterways will eventually designate Rock Island Arsenal as an inland port. It is manifest that such an event places the arsenal in a very fortunate strategic position.

To get the subject of "Rock Island Arsenal as a Center of Welding" in its correct prospective, it is necessary to consider some questions involved in the establishment of modern arsenals. Every first-class Power has at least one first-class arsenal equipped to radiate, in time of emergency, to the surrounding civilian factories, certain fundamental innovations of manufacture developed during periods of peace.

Many years ago, after the welding of aluminum had reached a point of development second to no similar activity in the civilian manufacturing world, it became apparent at Rock Island Arsenal that welded construction was to play an important part in the manufacture of various items of ordnance matériel. It was, of course, necessary to make a thorough study of the fundamentals involved in production welding of common metals and to get a welding program completely organized. It was also necessary to provide the right equipment and working conditions so that production costs could be kept down and quality and uniformity of workmanship maintained just as carefully as in other manufacturing operations.

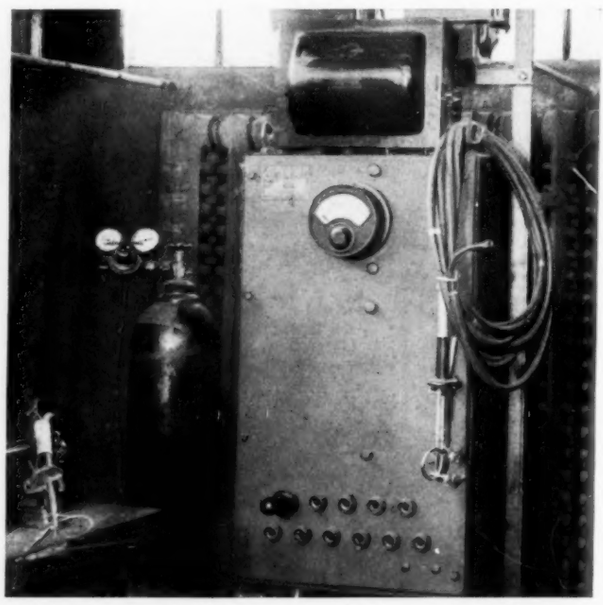

Fig. 2. Atomic Hydrogen Arc Welder at Rock Island.

Manufacture by the various welding processes at Rock Island Arsenal has been centralized principally in Shop O, which also contains the hydraulic press and power press department. It

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**Foreman, Welding Department, Rock Island Arsenal.

is conveniently located in relationship to Shop M, where the major assembly of all artillery vehicles and the various spare parts is conducted. This welding shop contains ample electric power, generated by turbines located in a modern hydro-electric power plant, arsenal-operated, which insures uninterrupted power at all times at minimum cost.

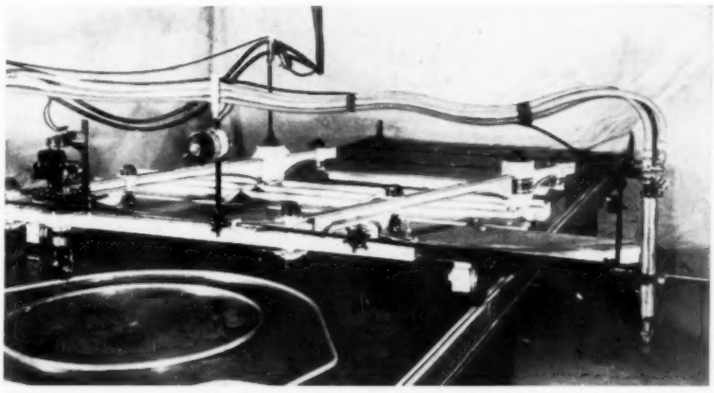

Fig. 3. Automatic Cutting Machine.

The welding equipment consists of one constant potential 500-amp. motor generator capable of supplying welding current simultaneously to a group of three operators on light fabrication, or to a group of two operators on heavy work. This generator is available also for supplying all current used on the automatic arc-welding machine (Fig. 1). The automatic arc welding machine referred to, the frame of which was designed and constructed at the arsenal, is capable of welding straight-line seams up to 16 feet in length, and is adapted for maintaining special fixtures for practically any type of work which can be welded on an automatic welder. This machine is also equipped with a semiautomatic electrode holder for use when hand-welding is required. The wire, however, is fed automatically from a reel, thus eliminating the necessity of constantly changing electrodes.

THE equipment further includes a circular automatic arc-welding machine, which was recently constructed at Rock Island Arsenal. This machine uses a variable speed, commercial type, motor-driven automatic-welding head with a flexible conduit terminating in a nozzle, through which a continuous length of electrode wire is fed by means of two revolving rolls mounted on the welding head.

There is also permanently installed one 300-amp., single operator's generator; and three 300-amp., portable, single operator's generators are available, each of which is capable of being moved to such jobs as are too heavy to be economically transported to the permanently installed machine. In addition, the arsenal has, in Shop M, one 300-amp., single operator's portable generator, which can be used for arc welding such jobs as are not desirable to move to the welding department proper. The arsenal also has a most modern 300-amp., atomic hydrogen arc-welding unit (Fig 2), which, of course, is used on work for which it is peculiarly adapted. The arsenal is equipped for all classes of acetylene welding. It has been employed for years on certain classes of welding where this particular type is advantageous and is still useful.

The automatic shape-cutting machine (Fig. 3) permits the use of a permanent template for continuous reproduction of the same shape. It is possible to construct comparatively inexpensive templates for this machine and thus to cut a small number of parts for which it would not be economical to provide the more expensive permanent templates. These temporary templates are usually made of wood or heavy cardboard. This machine is provided with a circular cutting attachment, which will cut circles up to 40 inches in diameter. Straight cuts are made by using a straight template which can be clamped at any point on the machine table. The apparatus has been used successfully for cutting all steel plate required for the recent construction of the 155-mm. gun—8-inch howitzer carriage, T2.

THE use of welded construction has been employed in recent years with a view to weight and cost reduction both in commercial and ordnance design of various items. A most interesting application of welding to artillery matériel has recently been completed on a damaged 75-mm. gun, model

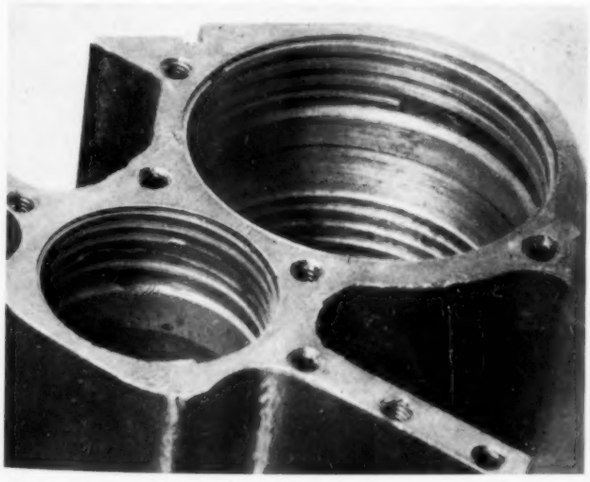

Fig. 4. Worn Threads of 75-mm. Recoil Mechanism as Received at Rock Island.

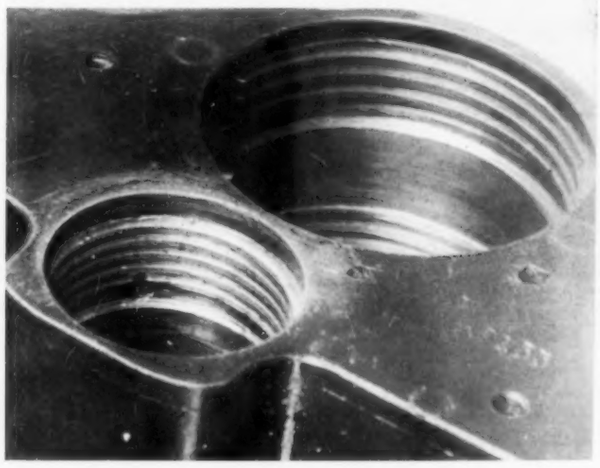

Fig. 5. New Metal Welded in and Machined. Same Mechanism as Shown in Fig. 4.

1897, recoil mechanism (Fig. 4), which was received at Rock Island Arsenal with the threads of both the head and stuffing box worn to approximately one-third of their original width. The remaining portion of the threads of the mechanism had not been stripped but were laid over when the head was forced out of the cradle by the pressure exerted at the end of recoil, while the threads of both the head and stuffing box were worn away by lapping action of the threads of the head against those of the stuffing box. Upon instructions from the Office of the Chief of Ordnance, this recoil mechanism was repaired by welding-in new material. The welding operation was successful (Fig. 5) and no difficulty was experienced on the machining of the threads. The welded mechanism was subjected to a specified hydrostatic pressure test of 7000 lbs. per square inch, and passed the test successfully. It was also proof-fired successfully, both of which indicate that the strength of the built-up thread is sufficient to warrant the return of the welded mechanism to service. The cost of welding, boring, re-threading, cutting key-way and testing is practically nothing compared with the high cost of a new recuperator.

Fig. 6. An Oxy-acetylene Welded Yoke and Adapter for an Aircraft Machine Gun Ring Mount.

One of the most interesting welding jobs performed at Rock Island Arsenal is the yoke and adapter of ring mount assembly, Type D-6 (Fig. 6), manufactured for the Army Air Corps and requiring the use of oxy-acetylene welding throughout. The yoke was first blanked out on the punch press. The radii on the edges were then milled and afterwards formed. The reinforced plate at the upper end of the spindle was assembled and welded in place. The hole which receives the spindle, having been previously punched, was reamed; then the spindle was inserted and welded permanently. The adapter was blanked and punched in one operation, and then formed; thereupon the washers were welded on both ends, with one on each side; an additional washer being welded at a point near the center for the trunnion bearing. The flanges were ground down flush with the face of the washers, welding in place the studs for carrying the magazine holder and water can. The bolt heads and trunnion bearings were then reamed in a fixture to insure perfect alignment. In addition, it was required to form the tube and fit the reinforce to the tube, and then weld it, after which the spindle bearing and two stops were properly located and welded in position. The spring cylinder is a piece of steel tubing with a disk welded into one end; to this disk is welded the pivot. A reinforce ring, made of rectangular bar stock and formed to shape, is tack-welded around the perimeter of the sleeve, flush with the open end. The magazine holder is constructed of flanged and formed units, the bottom of the holder being welded to the side members. Reinforcing wires, after being assembled at the top edge, are emplaced by welds at each end of the wire.

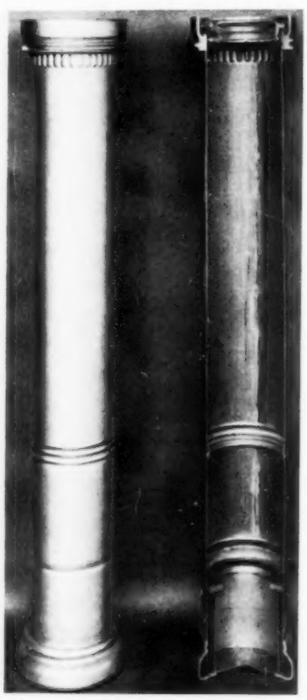

Fig. 7. Five-Inch Cartridge Tank Showing Welded Construction.

In the welding of aluminum sheets into 5-inch, 25 caliber tanks, Mark III (Fig. 7), for the United States Navy, the arsenal employed exclusively oxy-acetylene welding. The operations involved in the fabrication of these tanks were found to be difficult ones for the average welder; therefore, only experienced welders can undertake the work. Aluminum melts at a lower temperature than most metals and is very easily burned if care is not exercised. All welding of these tanks is done by coating the joint with a special flux, the neutralization of which requires great care, the aluminum sheet previously having been flanged to provide the proper cross-section for welding. The welds are then produced by the oxy-acetylene method, after which they are hammered to insure the proper grain structure. The cartridge tank is then subjected to an air pressure test of 5 pounds per square inch.

FIFTEEN steel work launches (motor), 28 by 7½ by 2 feet, have been constructed by arc-welding methods at the Rock Island Arsenal for the Corps of Engineers, U. S. Army, for use on the 9-foot channel development in the Mississippi River. All this material has been successfully launched (Fig. 8) in the Moline Pool at a point adjacent to Shop O. Although the standard of requirements exacted by the Corps of Engineers for material, workmanship, and especially for the deck and gunwale plating, is of the highest order, all these vessels have passed the service tests successfully. Not a rivet or bolt appears anywhere on the surface of the vessel except in the bulkhead, where it is required by the specifications to be removable. On these launches was used a special system of arc-welding developed at Rock Island Ar-

senal. One acetylene cutting torch and one arc-welding machine were used, and only four men were required for the construction of each boat within a period of fifteen days. Approximately 100 pounds of welding wire were used, as compared with 225 pounds of rivets which would have been necessary had riveting methods been employed. The estimated saving in costs of construction was 10 per cent. The original estimates proved accurate; in fact, a small sum of money was returned to the Corps of Engineers on some orders.

Because of the familiarity of the workmen at the Arsenal with this type of construction, which fact insured the Corps of Engineers of a very rapid and convenient date of delivery, the arsenal has been recently awarded a contract for three additional steel launches. In view of the rapid development contemplated by the Government on the Inland Waterways System, it may reasonably be supposed that considerable construction of this type of welded matériel may be expected in the future.

THE cartridge storage case, T1, (14 inches in diameter by 78 inches in length), for 12-inch gun (Fig 9) is also an interesting example of a production welding job in which a novel method of arc-welding is employed. These cartridge storage cases are made of a low carbon copper bearing steel. The material, which is 0.109-inch thick, was received from the rolling mills in sheets. From these sheets the bodies of the cases were sheared, embossed and rolled in preparation for welding longitudinal seams. All the welding of these cartridge cases was done on a production basis. The various parts were cut out in the most economical fashion, being so designed by the Office of the Chief of Ordnance. Extensive experience in the fabrication and assembly of cartridge storage cases has given Rock Island Arsenal employees a real working knowledge of design, which insures most efficient planning of the work. The parts are welded in such rotation that no time is lost. This cartridge case, which is an all-welded job, shows conclusively that automatic welding is the best method of joining metals in a strong, leak-proof union. After rolling, the body is placed in an especially constructed air-controlled fixture suitably mounted on the straight line, arc-welding machine previously described.

This fixture was constructed of structural steel plates cut to shape on the automatic gas-cutting machine (Fig. 5) and arc-welded into a complete unit. This design provides two upper jaws (spaced 1½ inch apart) which are held in place by bolts to facilitate removal and replacement when necessary. A lower clamping jaw (provided with a copper insert, acting as a chill bar) is actuated by air, such action being obtained from a standard 2½-inch fire hose sealed at each end and placed beneath the jaw. When air is injected into this hose by means of a standard valve, the hose is expanded, thereby raising the lower jaw and clamping the work against the two upper jaws. The clamping action is positive and quite rapid, owing to the fact that 90 pounds per square inch air pressure is employed.

Fig. 9. A Welded Cartridge Storage Case for 12-inch Gun.

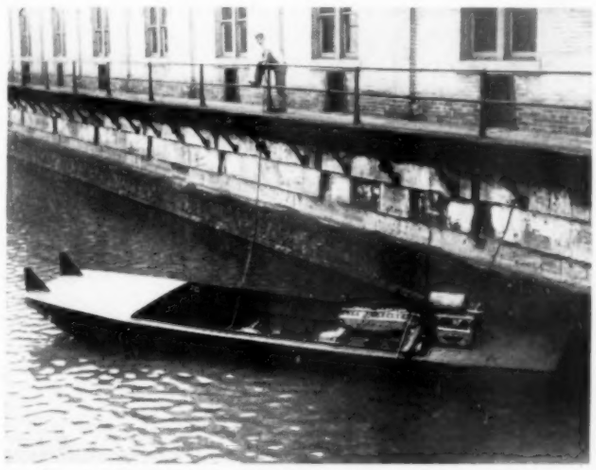

Fig. 8. Twenty-eight foot Steel Motor Launch of Welded Construction.

The body is then welded from end to end, which operation consumes 3 minutes and 5 seconds, actual welding time. (No difficulties of any nature were encountered in making this longitudinal weld.) The welding wire used throughout the entire job was 5/32-inch diameter, commercial type, supplied in 100-pound coils.

IN considering the wide range of possibility for automatic arc-welding from a production basis, all manufacturers are cognizant of the fact that it aims to reduce the human element as a factor. They also realize that maximum production is directly dependent on a proper selection of materials and correct machine setting. If the cumulative experiences of Rock Island Arsenal are briefly summarized, it will be more convincingly evident that production automatic arc-welding insures: Simplification of design; reduction of weight ratio without impairment of strength; minimum of expensive machining; ease of fabrication of otherwise inaccessible finished surfaces; inexpensive set-ups in machines; productivity within definite time limits, and lower costs.

Since the first artillery vehicles were constructed at Rock Island Arsenal, there has been an almost constant attempt on the part of ordnance engineers to reduce the ratio of weight of carriage to that of gun, without impairing the strength of the vehicle. To the reduction of this ratio, the engineers have devoted considerable thought and ingenuity. Electric arc-welding, both hand and automatic, makes this reduction possible. From one important viewpoint alone the large saving in delivery dates of the production of artillery matériel in the event of war, would quickly repay initial costs.

ARMY ORDNANCE

Published Bimonthly by
THE ARMY ORDNANCE ASSOCIATION
Washington, D. C.

NOVEMBER-DECEMBER, 1931

Month by Month

OTHER pronouncements of the American Legion in its recent national convention more popular than the need of munitions preparedness received the approval and acclaim of the country. Its straightforward stand on bonus legislation and its demand for relief from some of the evils of our present sumptuary laws were gratefully applauded by all except the few extremists who, to be consistent, should outlaw smokeless powder because of its alcoholic content. In the furor which accompanied these notable expressions of the Legion many lost sight of the splendid action taken on a subject more closely identified with our own field.

The Legion and Munitions Preparedness

The National Defense Committee of the Legion, under the chairmanship of Col. Chas. Burton Robbins, former Assistant Secretary of War, presented the following report which was adopted by the convention:

"The World War proved that the consumption of munitions in a modern war between major powers taxes to the utmost the industrial resources of the nations involved, and further proved that a period of one and one-half to two years must elapse after war is declared before manufacturing plants not experienced in the manufacture of munitions can obtain quantity production thereof. If the United States should engage again in war with a major power or powers, it must rely on private manufacturers for at least 95 per cent of the munitions required and such manufacturers are getting in time of peace practically no experience in the manufacture of munitions.

"It would be impracticable to maintain in time of peace a war reserve of munitions sufficient to last throughout the whole of a major war, and our present war reserve is wholly inadequate to last until sufficient additional munitions can be obtained from production started after war is declared, and this reserve is rapidly becoming obsolete and deteriorated.

"The mobilization of required man power will demand a rapidity of supply of arms and ammunition that can be attained only by the active peace-time training and practice of private manufacturing plants in the specialized production methods and processes involved."

There have been times when the Legion seemed to be drawing a wide line of demarcation between the man behind the gun and the man behind the lathe in war. Happily the point was never pressed to extremes as both fill an essential place when peace is threatened. For this unity of purpose there is, of course, only the highest of praise. And for the Legion's pronouncement on munitions preparedness and the all-important necessity of educational orders for munitions there is additional praise.

COL. HENRY W. MILLER, Ord. Res., whose researches and application in the field of light and heavy artillery are well known, has performed another valuable service for ordnance followers in compiling a cumulative index to Army Ordnance. An undertaking long planned but not accomplished by the Association has now been gratuitously performed by Colonel Miller who thus makes available a valuable adjunct for those who are keeping bound copies of the Journal. Heretofore it has been a rather cumbersome proposition to find, throughout the twelve volumes, all the data which have been published in these pages on any particular subject, inasmuch as reference to twelve individual indexes was necessary. By preparing a cumulative index Colonel Miller has done much to lighten the burden of munitions research.

A Cumulative Index to Army Ordnance

The cumulative index is prepared in card size, the individual titles being reproduced on the usual medium weight blue print paper. In this form the index is readily expandable to include future issues. As a further indication of the compiler's whole-hearted interest in the matter, copies of the index for the first eleven volumes may be purchased at the cost of the material and machine operator's labor. Consequently readers of Army Ordnance may purchase the cumulative index to date in this form for $6.00. Since the labor required to sort the titles alphabetically is considerable, purchasers at this price will not be supplied the index in alphabetical arrangement. Indeed the mere classification of titles by the reader is a refreshing and intersting occupation and in itself should be of value in recalling the wide range of subjects included in the index.

In view of Colonel Miller's already painstaking effort in arranging the compilation it is preferred that readers desiring copies of the index perform the alphabetical arranging themselves. Army Ordnance will be pleased to accept orders from all members and subscribers at the above price plus postage. Colonel Miller further assures that he will keep the index up-to-date as each volume of the Journal is completed and estimates that additional index cards for each new volume will cost not more than 75 cents a set.

FIT the arms to the infantry, and not the infantry to the arms says Colonel Fischer of the German Army in a recent article on infantry armament in *Heerestechnik*, the technical journal of that army. The title of the article, "Special or Unit Arms for the Infantry" suggests the question of having more and more special arms for the infantry or getting down to fewer more general purpose arms. It is an excellent study.

Which Comes First, Tactics or Matériel?

The author says that the infantrymen themselves are not well enough versed in armament and gunnery to form an independent opinion, let alone evolving something themselves. As a result, the design of arms is turned over to technical experts who are not infantrymen and who have no proper conception of the battle conditions under which infantrymen must use their arms.

Then the author points out, "It requires no special vision to understand that a defense weapon created for such purposes must be convenient and mobile so that the creeping and crawling infantryman can drag it from shell hole to shell hole." He says that experience has taught that this is possible with the machine gun but with nothing heavier.

Unmindful of such conditions the technical experts designed, manufactured, and provided for the infantryman to carry with him, in addition to his pack, the following armament: (1) Rifle with side arms, (2) hand grenades, (3) rifle grenades, (4) light machine guns, (5) heavy machine guns, (6) extra heavy or antiaircraft machine guns, (7) flat trajectory guns for antitank purposes, (8) infantry howitzers, (9) infantry mortars or minenwerfers.

Commenting on this list the author says, "It appears on the first glance that this solution cannot be represented as one appropriate for the infantry's own purposes. It is plain to be seen that the professionally educated infantryman should be given more influence.

"A one-sided and thoughtless specialization wishing to produce the most perfect results will show itself to be the worst enemy of the troops for what is so unfair as to fit the troops to the arms and not the arms to the troops?"

Springfield—A Repository of Firearms

SINCE that day in 1789 when General Washington inspected it, the Springfield Armory has filled an important place in the annals of our country. For nearly a century and a half the Armory has followed the tenor of its way in war and peace. Until 1842 it produced the French Charlesville smooth-bore musket, model 1763, caliber .69. In 1855 manufacture of the first rifled musket was begun and an elongated bullet replaced the ball. In 1866 the breech-loading rifle was introduced. In 1873 the first "Springfield Rifle," a single-shot caliber .45 weapon, appeared. In 1892 came the Kragg-Jorgensen bolt action caliber .30 magazine rifle. And in 1903, the U. S. Rifle, caliber .30 was produced.

Surely no more fitting repository exists for assembling in its museum examples of small arms than at this veteran and historic place. The Springfield collection long has been known for its completeness and authenticity but there are gaps to be filled and in the filling readers of ARMY ORDNANCE can help. Recently a rather disastrous fire in the museum partly damaged some of the valuable specimens. Although it will take some time to put the collection in condition again, the damage was not irreparable. It is the hope of the Armory authorities to have the museum rearranged within a year with a better classification of weapons than before. Readers who have in their possession guns, ammunition or personal accoutrement which will augment this already outstanding collection may be seeking a repository where their prize possession will take its place insured against the disinterestedness of a coming generation of descendants.

Commissar Voroshiloff on Industrial Preparedness

WAR Commissar Voroshiloff of Russia during a recent inspection trip through Siberia took occasion to dwell upon industrial preparedness—although from a viewpoint which differs very materially from our own. One of his places of visitation was the Kuznetz steel plant now under construction. Addressing the workers there M. Voroshiloff is reported by the *New York Times,* to have said, "Your construction is being watched not only by the proletariat of our union but by the whole international working class. That is not only because workers from France, Germany, England and America are working shoulder to shoulder with you but because along with Selmash, Magnitogorsk, Dnieprostroy and other giants of Soviet industry, your metallurgic plant will decide the question of who shall prevail and will arm the international proletariat for the struggle for socialism. The vast role which these giants will play in business and in our national defense requires no demonstration."

The new Russia quite logically is putting to work resources which can be of material benefit to her own people. And with such development very properly goes the utilization of her industrial strength for national defense. The distinction, however, between industrial preparedness as we in America have fashioned it here and as Commissar Voroshiloff interprets it for Russia is entirely in the avowed purposes of its use. With us it is a first line of munitions reserve in the event of aggression; with him it is this and a great deal more. And it is precisely in the objective that this or any other military plan becomes a threat rather than a safeguard. Possibly the economic peace-time advantages of Kuznetz once proved will temper the vision of the commissar and postpone the materialization of the other uses to which he now proposes to put it.

The Importance of Sighting Equipment

THE whites of the enemy's eyes are no longer used as targets and sighting equipment today has progressed accordingly. Thus then attaches unusual significance to recent tests in the all-important field of accuracy of gun fire. At the Aberdeen Proving Ground three instruments are under consideration to determine the most accurate type of height finder available; one manufactured by the Bausch & Lomb Company, one by the Nederlandsche Instrumenten Companie and the third by the Compagnie Optique et Precision de Levallois. All three instruments are four meters in length and are stereoscopic in principle, actually measuring the slant range to the target and automatically converting slant range to height for use in the antiaircraft director. The tests consist of measuring the height of planes flying at varying altitudes up to at least 15,000 feet, and at varying slant ranges.

Another advancement in this field is a new sight which, it is claimed, will markedly improve the accuracy of bombing from airplanes. This is a development of M. Georges Esstopey of the Gaertner Scientific Corporation. This sight has an automatic device by which the sight can be synchronized with the target within 3 to 4 seconds.

As the bomber strives for accuracy so his arch enemy, the gun, does likewise. That both may do their respective jobs with dependable precision is an important objective.

Some Popular Misconceptions of Military Armament

An Editorial

POOR old armament is being blamed for everything that's wrong with the world! With trepidation we anxiously await word from some learned specialist in children's ailments attributing a local epidemic of measles somewhere to the much maligned production of weapons! So absurd a finding would not be more fantastic than some of the welter of opinion with which the daily press is flooded on the subject of armament. It seems that all the ills to which human kind is heir must be tied to the latchstring of the arsenal on the theory that he who makes a gun will be an aggressor and that he who does not will be conquered. The absurdity of this and similar notions would be comical were it not quite so tragic in its application.

We have no thought here of suggesting that commendable efforts to curtail current expenses of the nations in time of economic stringency are thus to be classed. Obviously we sponsor no such travesty as a race of armaments. But between a sensible road to these objectives and national defense stands that growing popular tendency to outlaw armament as a thing vicious *per se,* for which there can be no good use, and from which every evil springs. And this at a time when the rumblings of conflict and accounts of actual hostilities occupy the headlines of the daily paper. Something is out of joint—no doubt. We believe it to be in the popular misconceptions of our national defense system.

Armistice Day this year was seized upon as a fitting occasion for scholars, statesmen and propagandists to argue the case against armament and to plead for its annihilation in the United States and elsewhere. This apparently on the theory that tribute to the heroic soldiers of the World War demanded a repudiation of another major conflict. As usual the "munitions makers" came in for their share of the blame.

OUR military defense plans in their broad outline are no secret. They are clearly recorded. And if there is any one startling fact that stands out in them it is their simple purpose and their direct and sensible means of maintaining it. For even the man in the street to be ignorant of them is scarcely pardonable; for the man on the rostrum to minimize them is a matter of grave concern.

Much is said of the present danger of militarism. We have not even the shadow of such a thing in the United States and have never had it in our history. Much is said of the error of quantity munitions production in the United States—again we have no such thing. The truth is that we have a peace-time army of minimum size and peace-time munitionment of education and experiment. We have neither a large standing army nor even a commensurate program of military armament. Of the size and cost of our military establishment the fair critic must concede not only their reasonableness but even their low ratios. As to size, we have in commissioned, warrant officer and enlisted strength some 130,000 professional soldiers in a population of 122,000,000 or one soldier to every 916 civilians—not a very formidable ratio.

As to cost, the comparison is equally startling. The total budget estimates for the War Department to be submitted to the Congress this year, on the basis of a $44,000,000 reduction from total appropriations for the current fiscal year, are roughly $437,000,000. For the current year the total appropriation is $481,565,713. And this sum does not pertain to military operations alone but covers the non-military activities as well. It includes $335,475,965 for military and departmental expenditures, $99,596,084 for non-military purposes and $11,495,686 for the operation of the Panama Canal. In addition, there were two emergency appropriations by the Congress totalling $35,000,000 for disbursement by the War Department for unemplopment relief. The military and departmental appropriation properly can be considered as the cost of our military defense. It compares with a total national budget of $3,932,842,411 and with an estimated national wealth of $360,000,000,000. Again not a very formidable ratio!

BUT the question of our military armament can be analyzed even more closely and without talking of hundreds much less of millions. The Ordnance Department of the Army is charged with the design, development, manufacture, supply and maintenance of our military munitions. The annual report of the Chief of Ordnance for the past fiscal year is indicative of the new military armament procured for our service. General Hof states that the following items were procured: fifteen 75-mm. pack howitzers, fifteen 3-inch antiaircraft mobile guns, eleven 37-mm. guns, twelve 75-mm. mortars, four 105-mm. howitzers and 20 Garand semiautomatic rifles. This is a total of seventy-seven weapons of all classes, large and small. Not a very militaristic-sounding total nor a very sizable addition to our armament.

But it speaks very tellingly of what our military defense system consists today. It is concrete evidence of the limited character of new production—simply enough to enable a necessary art to survive and to provide our forces with a few of the new types. At such a rate of rearmament, if rearmament were an objective, few men living will see the day when our Army is equipped throughout with modern tools of war.

Why then the great hue and cry about competitive armament, its dangers, its excessive cost and its unreasonable relationships insofar as our country is concerned? The answer is hard to find. It may lie in the unwarranted altruism and idealism of those who believe in the face of very damaging evidence to the contrary that the human race suddenly has been made over in the last decade. It may be found in the benighted outlook of those who contend that to provide for the protection of one's homeland is to grasp the sword and perish by it. It may be, despite the imminence of war in certain localities and actual conflict in others, that after all there are no such things as aggression and the need for defense. In which case the specialist who attributes a local epidemic of measles to our huge (!) military armament will probably be not far from correct. He will stand side by side with those other misguided ladies and gentlemen of whom it can be said, as was said centuries ago, "Judgment, thou art fled to brutish beasts and men have lost their reason."

Association Affairs

Washington Post

A MEETING of the Washington Post, in compliment to distinguished guests who were in attendance for the annual meeting of the Ordnance District Chiefs in Washington and to officials and members of the Army Ordnance Association, was held at the Army-Navy Country Club, Washington, October 7th. Lieut. Col. Charles G. Mettler, president of the post, presided and presented his successor in that office, Lieut. Col. Earl McFarland.

Among the distinguished guests were the Assistant Secretary of War, Hon. Frederick H. Payne; Maj. Gen. Samuel Hof, Chief of Ordnance; Brig. Gens. W. H. Tschappat and E. D. Bricker, Assistants to the Chief of Ordnance; Brig. Gen. Benedict Crowell, President of the Army Ordnance Association; Mr. Alexander Dow, President, Detroit Edison Company; and the following officers of the Ordnance Districts: Col. C. L. Harrison, Cincinnati; Col. Chas. H. Tenney, Boston; Mr. John C. Jones, Philadelphia; Col. Theodore Swann, Birmingham; Col. B. A. Franklin, Bridgeport; Col. M. E. Singleton, St. Louis; Lieut. Col. Winthrop Withington, Cleveland; Mr. Frank B. Bell and Lieut. Col. H. A. Gidney, Pittsburgh; and the executive officers of the districts.

Colonel Mettler, who at this meeting relinquished the duties of president of the post because of his transfer to active duty in New York, concluded a most successful tenure of office. During his incumbency the post held regular meetings and through his efforts many distinguished speakers addressed the organization.

The new president of the post, Colonel McFarland, is well known in ordnance circles and has distinguished himself in many important assignments which he has filled during his military career. Under his leadership the activities of the post are certain to continue in interest and value both to the members of the local organization and to the National Association.

General Delafield Receives Italian Decoration

BRIG. GEN. JOHN ROSS DELAFIELD, Ord. Res., counsel of the Army Ordnance Association and a leading figure in national defense activities, received the decoration of Commander of the Order of the Crown of Italy, October 8, 1931. The ceremony incident to the bestowal of the decoration was held at Governors Island, New York, in the presence of a distinguished company of military and civilian leaders.

After the decoration had been conferred by Italian Consul General Emmanuele Grazzi, the 16th Infantry was reviewed by General Delafield, following which a reception was held at the Officers Club.

Retirement of John A. Madigan

MR. JOHN A. MADIGAN, a charter member of the Army Ordnance Association and for nearly half a century a valued employee of the Office of the Chief of Ordnance, will be retired from active service November 30, 1931.

Typifying that great corps of civilian employees of the Department which embodies the continuity so necessary to efficient operation, Mr. Madigan entered the service of the Department in 1883, completing more than 48 years of active and responsible work. He will be remembered as the efficient head of the Mail and Record branch, an office which he filled for many years. On behalf of his many friends in the Association we extend congratulations on a splendid record of service and best wishes for the happiness and comfort of retirement he deserves so well.

Necrology

Samuel W. Stratton

IN the death of Dr. Samuel W. Stratton which occurred suddenly on October 18, 1931, while he was dictating a letter of condolence to the widow of his friend and associate, Mr. Thos. A. Edison, the country has lost a man who had given his whole life to science and to the development of scientific research.

The Bureau of Standards which he started and of which he was head until he was called to the Presidency of Massachusetts Institute of Technology about eight years ago, was developed under his guidance into one of the greatest scientific research laboratories in the world.

During the late war the Bureau carried out many investigations of great value to the Army and to the Navy. Realizing that most of the optical glass used in this country came from abroad and believing that later the United States would be drawn into the conflict, Dr. Stratton, through the Bureau of Standards, developed the manufacture of an optical glass in this country.

As President of the Massachusetts Institute of Technology, Dr. Stratton was always willing to foster any research which was worthwhile, no matter whether such research were undertaken by a student or by a member of the instructing staff. During his administration as President the number of graduate students who were candidates for a higher degree at Technology, increased from eight to ten times the previous enrollment for such work. An Aeronautical Building, an Infirmary housing the Medical Department, and a laboratory for internal combustion engines were added to the educational group while he was President.

Dr. Stratton took a particular interest in the work of the five units of the R. O. T. C. allotted to Technology. He often remarked that the 180 or 190 young men who were commissioned each year at graduation as second lieutenants in the reserve were a most valuable asset to the country in a time of emergency. In his younger days he was enrolled in the Naval Reserve and at the time of the Spanish War he was called to active duty on the SCORPION—a converted yacht. His interest in the work of the thirty or more regular Army officers and Naval officers who are detailed to Tech each year was most keen. He was always ready to extend to the Army and to the Navy the facilities of the Institute and through his invitation the various military organizations in and around Boston have for years held their lectures in the class rooms at Massachusetts Institute of Technology. Dr. Stratton was an ideal host and a man's man.

COL. EDWARD F. MILLER, *Aux. Res.*,
Dean of Army Students,
Massachusetts Institute of Technology.

Lieut. Col. Alexander W. Maish

LT. COL. ALEXANDER W. MAISH, Ord. Dept., U. S. Army, retired, whose notable record as an ordnance officer stands high in the annals of the Department, died in Washing-

ton September 25, 1931, at the Walter Reed Hospital. A charter member of the Army Ordnance Association, Colonel Maish was always active in its affairs and was instrumental in the establishment of the New York Post in 1921.

Born August 28, 1884, in Pennsylvania, he was graduated from the United States Military Academy in 1907 and appointed a second lieutenant of the 12th Infantry. He was detailed to the Ordnance Department in July, 1903, and thereafter served at the Sandy Hook Proving Ground and at the Rock Island Arsenal. Upon his return to the Infantry in 1912 he served as a member of a commission of the General Staff to witness maneuvers of the British and German armies in that year. Promoted to captain he was redetailed to the Ordnance Department and assigned to the Watertown Arsenal. He served at various Ordnance establishments until the outbreak of the World War. In October, 1917, he went to France where he served with the Equipment Division and later at Tours as Assistant to the Chief Ordnance Officer, A. E. F., in charge of proving grounds and laboratories. For his World War service he was cited by General Pershing for exceptionally meritorious service.

Samuel Mather

MR. SAMUEL MATHER, chairman of the Advisory Board of the Cleveland Ordnance District and a member of the Army Ordnance Association for many years, died in Cleveland October 18, 1931. A leading capitalist of the country, Mr. Mather was an enthusiastic exponent of industrial preparedness and through his interest and activity aided materially in furthering the work of industrial planning in the Cleveland Ordnance District. Through his long years of industrial leadership Mr. Mather was identified with the United States Steel Corp., the New York Central Railroad, Cleveland Cliffs Iron Co., Bankers Trust Company of New York, and American Shipbuilding Company. He was the senior member of the firm of Pickands, Mather and Company, a vice-president and trustee of the Western Reserve University and trustee of the Cleveland Museum of Art.

H. P. Davis

DR. H. P. DAVIS, a charter member of the Association and a director of the Pittsburgh Post, died September 10, 1931. Known as the "father of broadcasting," Dr. Davis was among the first to appreciate the possibilities of radio broadcasting. In November, 1920, he established the Westinghouse station, KDKA, in Pittsburgh. He had served with the Westinghouse Electric & Manufacturing Co. since 1891, becoming vice-president in charge of manufacturing and engineering activities in 1911. During the World War he was in charge of all munitions production of the Westinghouse Company.

Col. Isaac N. Lewis

COL. ISAAC NEWTON LEWIS, inventor of the Lewis machine gun and of other devices of military use, died suddenly in Hoboken, N. J., November 9, 1931. Colonel Lewis was born in Salem, Pa., October, 1858, and was graduated from the United States Military Academy in 1884. He served at various Ordnance establishments until his retirement, 1913.

Among other inventions perfected by Colonel Lewis were his time interval clock and balance system of signals for coast defense batteries, quick-reading mechanical verniers and a rapid-fire field gun and mount. He also invented a device for lighting railroad trains electrically by means of a self-regulating dynamo operating from car axles and a method of providing electric power for rural homes by using windmills as generators.

Colonel Lewis' chief fame is as the inventor of the Lewis machine gun. After his retirement from the Army he effected an exclusive manufacturing alliance with the Birmingham Small Arms Company of Birmingham, England, and during the World War more than 100,000 Lewis machine guns were used by the Allies. The Lewis gun was used by the United States Army during the World War mainly as an aircraft weapon.

SINCE publication of the last issue of ARMY ORDNANCE notice has been received of the death of the following members of the Association: W. R. Addicks, New York, N. Y.; Charles Day, Philadelphia, Pa.; Victor E. Edwards, West Boylston, Mass.; Oren S. Hussey, Nashua, N. H.; Harry McManus, Philadelphia, Pa.; O. Curtis Purdy, Wilmington, Del.; J. Sheppard Smith, St. Louis, Mo.; and Joseph B. Terbell, New York, N. Y. To the relatives and friends of these deceased members the Association extends condolences.

New Members

THE following have been admitted to membership in the Association since the last issue of ARMY ORDNANCE: James C. Alban, Baltimore, Md.; P. A. Babb, Dover, N. J.; George H. Bardsley, Dover, N. J.; Alfred F. Barnard, Jr., Bethlehem, Pa.; A. S. Bickham, Princeton, N. J.; Maurice E. Bosley, Chicago, Ill.; Nelson L. Buck, Dover, N. J.; J. Burklow, Wharton, N. J.; Frederick E. Byrne, Dover, N. J.; John Campbell, Jr., Princeton, N. J.; Samuel H. Con'e, Wilmington, Del.; C. I. Cook, Kimberly, Nev.; Wm. S. Covington, Washington, D. C.; J. C. Elgin, Princeton, N. J.; Cashius F. Elmore, Portsmouth, Va.; Harvey S. Farrow, Wilmington, Del.; Julian W. Feiss, Cleveland, Ohio; W. W. Ferrier, St. Louis, Mo.; Dan G. Fichter, Wharton, N. J.; Cass Gilbert, Jr., New York, N. Y.; Ernest R. Gillespie, Pedricktown, N. J.; George T. Griffin, Pedricktown, N. J.; Arthur V. Harrington, Stoneham, Mass.; John W. Harrington, Worcester, Mass.; W. H. Harris, Princeton, N. J.; Reginald W. Hay, Philadelphia, Pa.; John M. Hazen, Bethlehem, Pa.; Louis J. Herr, Washington, D. C.; Wayman A. Holland, Lansdowne, Pa.; Addison F. Holmes, Winchester, Mass.; E. J. Hottinger, Kenvil, N. J.

Everett T. House, Farmington, Conn.; Frank J. Jacobs, Atlantic City, N. J.; Ellery S. James, New York, N. Y.; Joseph F. Jonas, Wharton, N. J.; George H. Keller, Bethlehem, Pa.; Theodore E. Kendrick, Yorktown, Va.; Richard N. Laftman, Bethlehem, Pa.; Harry Leasim, New York, N. Y.; Harold E. Little, Wharton, N. J.; Richard A. Lodge, Bethlehem, Pa.; M. L. Matheson, Dover, N. J.; Lloyd W. Mathews, Wharton, N. J.; W. B. McAllister, Cleveland, Ohio; F. P. McBerty, Warren, Ohio; Frank M. McCullough, Dover, N. J.; Alvin E. Michel, Dover, N. J.; Lewis B. Miller, Manville, N. J.; William F. Miller, York, Pa.; Joseph A. Molnar, Dover, N. J.; J. T. Moran, Rockaway, N. J.; Thomas J. Moran, Brookline, Mass.; W. P. Penniman, Wilmington, Del.; E. K. Persbacker, Wharton, N. J.; John T. Remey, New York, N. Y.; J. C. Rhoads, Bethlehem, Pa.; J. H. Robinson, Dover, N. J.; S. M. Rodgers, Princeton, N. J.; G. E. Rogers, Rockaway, N. J.; W. M. Rowe, Wharton, N. J.; Raymond C. Rusch, Wharton, N. J.

R. B. Silverman, Douglas, Ariz.; H. D. Smith, New Haven, Conn.; Frank L. Snavely, Bethlehem, Pa.; Richard L. Snyder, Jr., Bethlehem, Pa.; A. E. Sorenson, Princeton, N. J.; F. N. Spencer, Jr., Princeton, N. J.; Robert L. Sprinkel, Jr., Sacramento, Calif.; Raymond G. Stilwell, Rockaway, N. J.; A. J. Taylor, Wharton, N. J.; J. A. Taylor, Rockaway, N. J.; Matthew Thompson, Dover, N. J.; Carel T. Torresen, Overlea, Md.; F. S. Van Ness, Dover, N. J.; Newman E. Walton, Dover, N. J.; F. E. Watling, Dover, N. J.; William H. Webster, Bethlehem, Pa.; W. Wettach, Princeton, N. J.; James R. White, New York, N. Y.; Richard L. Willis, Bethlehem, Pa., and Franklin B. Wise, Bethlehem, Pa.

Communications

The Tank, A Secondary Offensive Weapon

THE EDITOR:

I have read with interest the articles by Colonel Wagner of the Bartlett Hayward Company on the mechanics and the tactical possibilities of the tank. Before adding any discussion to these splendid development studies of this arm of the service, let me express a word of sincere approval of the idea of studies of this kind made by men directly connected with industry and the unselfishness of the regular officers in favoring their publication for general use.

From a strategic standpoint I believe that there would arise in any open discussion a violent disagreement as to the eventual utility of the tank as a primary weapon of attack. I sometimes feel that we are gradually slipping back into the ancient error of basing our judgments of the needs of the next war on those of the last. It is conceded that in spite of great advances in mechanism in the ten-year period 1904-1914 Germany made a fundamental error in basing judgments on what happened during the Russo-Japanese War. Now, after a thirteen-year period, in spite of an infinitely greater mechanical advance, we are still basing judgments for future emergencies on the old needs of 1918.

I am afraid that we Ordnance officers are notably lacking in strategic thinking, especially Ordnance officers who have not come into close contact with the executive staffs of the line units. In my opinion lessons can be learned from a passed-and-gone war only by taking proper consideration of mechanical development since that war and by deducing the strategic utility of those developments in the light of relative strategic advances between former wars. The perverse, almost laughable, insistence of the British ordnance authorities during the first two years of the World War on all rifles with precise sights for distances of 2,500 yards or more alone showed that they were still figuring on the basis of the sharpshooters of the Boer and Cuban Wars.

Further development work on the tank is well worth while, but I cannot conceive that the tank in large quantities will be called for as a first requisite in any major war that may come in the future. Perhaps I am reckless in saying that I cannot picture it in any place except for secondary clean-up requirements or for internal disorders. The present economic and political tendencies in all the civilized countries that could possibly wage a major machine-age war indicate clearly that such a war would be coalition against coalition rather than country against country. It has always been presumed that God is on the side with the biggest cannon, or in other words, the side that "gets there fustest with the mustest," but a complete change in offensive weapons may even alter that. Clever and unscrupulous usage of mechanical, electrical and chemical inventions may count most. Let us get one thing clearly out of our heads, and that is, any conception that in the next war vast armies will be facing each other in open trenches. Let us see why not:

1. Developments in corrosion and wear-resistant steels, in methods of changing gun liners, and in knowledge of the effects of decreasing air pressure on the trajectory at high elevations, have made eminently practical the long-range gun of from 75 to 200 miles.

2. Aircraft, which was in its infancy in 1914-18, is now a first-line offensive weapon. Twelve hours after declaration of war, planes of either side can be destroying inland cities of the opposing powers, from 2,000 to 4,000 miles distant. Speeds of 400 miles per hour are already projected. A determined or fanatical enemy will not count on return trips, but will carry high explosives and gases to capacity, sacrificing the aircraft and pilots. Tree and foliage-destroying chemicals will also be carried and scattered.

3. Self-propelled long-range projectiles and rockets are practical and could be manufactured in quantity more rapidly and economically than tanks or heavy artillery.

4. Long range or self-propelled flame throwers and chemical carriers will prevent positively any dense concentration of men.

5. Present knowledge of the destruction power of electronic waves of very high frequencies might easily be developed further under the feverish activity of war into invisible weapons of long distance destruction of personnel.

Destructive defense will be fought with the same weapons. The tank and speedy armored cars can easily be usesful in clean-ups or minor offensives, and aircraft, medium-range guns, and conveniently operated rockets and grenades for H. E., gas, and flame will also probably figure in clean-ups. But protective defense will have to desert the trench for dugouts, chemically inert clothing, head masks, oxygen carriers, and possibly radio-wave deflectors. First-line offensive by opposing major forces will be against manufacturing centers and food-producing areas even more than against field armies. In any economic coalition as mentioned above there will be the gravest danger of widespread-concerted action of "Tories" at home, and against these the tank may have its use, but I cannot visualize the tank in anything but a secondary position as an offensive weapon between opposing major forces.

GEORGE S. BRADY, Lieut. Col., Ord. Res.,
New York, N. Y. *Managing Editor, "Product Engineering."*

Mass Production: America's Hope in Peace and War

THE EDITOR:

Compared with other nations we are essentially on a mass production basis in a large number of our manufactured products. During the last war, a few of our shell plants were on a strictly mass production basis. Some had just gotten into it when the war ended.

What is mass production? Is it not the production of a commodity in abnormally large quantities in unit time with a continuous flow of the raw materials to the finished product in a constant direction at the maximum obtainable speed? Under what conditions can this best be accomplished? We learned during the last war, particularly in the Canadian shell plants, that with unskilled machine operators, consisting of women and wounded men returned from the front, the rate of shell production on single purpose machines was very considerably higher than plants equipped with combination of multiple purpose machines using valuable skilled labor. It was also observed that plants operating with single purpose machines reached the maximum output in a shorter period of time with fewer interruptions in the production flow caused by breakdowns, etc.

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The type of producing equipment is a vital factor in securing maximum production at minimum expense of time, labor and finance. We can take an ordinary type of machine tool such as a lathe, drill press, boring machine, and other mongrel machines and equip them with more or less expensive tools and fixtures for the production of a war commodity as was done by many producers of munitions during the late war with very unsatisfactory results. It was natural to believe that this was the only expedient in those times of emergency. Plants accepting war contracts with no suitable equipment delayed production many months with a waste of many millions of dollars "finding out how" with the consequent loss of valuable time and unnecessary sacrifice of many lives. The question has been asked many times, can this policy of Industrial Preparedness be continued with any degree of certainty, that our war requirements of vast quantities of matériel in another major emergency will be satisfactorily met at the "jump off" or shortly after?

It is believed that the following principles are patent. If we are forced to use the maximum of personnel unfit for combat service, single purpose machines only can be used for maximum war production. If the maximum continuous flow of a product is to be maintained, single purpose machines adapted for the purpose are required. If the flow of a product in a constant direction is to be maintained, the number of producing plants should be limited and on a mass production basis, using single purpose machines.

If the War Industries Board adopted the general policy of mass production with single purpose machines, the question would arise, how would thousands of manufacturing plants be best drafted into service as they are themselves valuable potential producers. The answer to this may be that many such concerns would well build the producing single purpose machines and others the necessary tools and fixtures. The design of these machines and tools together with a sample machine tested out in actual service should be ready for instant production on order from the War Department. In times of peace it would mean that as soon as an ordnance weapon or an element had been approved for service, the Ordnance Department would design or cause to be designed the type of single purpose machine with tools best adapted for its production. If the duration of the war were lengthened and the production demand were execssive many of those plants manufacturing equipment would in addition be drafted into munitions-producing plants using the same equipment served others. This system leads to centralized executive control with decentralized administration which may be desirable under war conditions.

We have many forms of food products derived from wheat, some of which constitute a part of the rations served the Army. Can not wheat be best produced on a mass production basis in times of both peace and war? We are told by one of the largest wheat producers in this country that it can be produced on a mass production basis with proper agricultural equipment at 10 cents per bushel f. o. b. cars. Is not this the answer to stabilization of profits on wheat production? If we are to command the wheat markets of the world and maintain our present standard of living shall we not have to produce wheat cheaper on a mass production basis with the use of the best adapted mechanical equipment? Traditionally and in times past Yankee genius and capital have risen to their opportunities. Will they fail us in these times of distress?

In our military preparedness are we not training the potential defenders of our country on a mass production basis as exemplified in the methods used in training our R. O. T. C., C. M. T. C., O. R. C., and National Guard units? To mass quantities of potential combat personnel the elements of single purposes or objectives are progressively taught one at a time in a continuous flow from the raw recruit to the trained soldier and officer.

It is felt by many that our national game of American foot-

ball as played by the colleges and secondary schools of this country constitutes valuable training for our youth who may be called to combat service in later years. It is a species of mimic warfare. Players gain experience in self control and resourcefulness against determined opposition and are trained in coördinated team work to win their objectives under most adverse conditions. Can American football be "over emphasized" if it is a valuable adjunct to military preparedness in national defense? A football game kindles in the players and spectators a patriotic spirit of thrills much like that experienced by spirited troops engaged in aggressive combat with a hostile foe.

We are in the throes of a fast changing world. Are we drowsily indifferent to the tremendous radical changes affecting our economic, social, and political relations both nationally and internationally? Shall the elements of destruction in defense of home and country be projected from the air above or the earth below or both? Does Industrial Preparedness balance with Military Preparedness? Shall "That nation without vision shall perish from the earth" apply to America? May the people of this strong land move *en masse* without waver, fear, or halt in the one direction with a single purpose under the Washingtonian doctrine "In times of peace prepare for war."

C. E. COOLIDGE, Lieut. Col., Ord Res.,
Atlanta, Ga. *Georgia School of Technology.*

War Labor Policies

THE EDITOR:

It is assumed that the War Department has had reports on labor policies made by some of its committees and that the various districts of the Manufacturing Service, Ordnance Department, contemplate having local labor boards. Thus far however there has been no attempt to establish or at least publish the duties and principles of such boards.

Logically to be in step with production by districts, and practically to achieve results, the handling of the labor question should be decentralized. Therefore the districts need to study the subject and establish proposed policies and practices. In fact this is true whether or not the labor question is decentralized, since no centralization will remove the local need for intelligent coöperation.

It is believed that it is just as unsound to argue for a fixed wage as it is for labor leaders to fight for every possible increase and thereafter to oppose any reduction. As an example, there is the 1931 attitude of labor leaders, in a certain State, that the rate for ironworkers must be $16.00 per day when the pre-war rate was $5.60. If the wages of either capital or labor are allowed to increase unreasonably the post-war adjustment is delayed.

Since the probable issues will not be between low and lower wages, the so-called starvation wages, but between high and higher wages, the humanitarian question is not involved. In such cases and in the event of strikes it is probable that the determining factor will be police protection. In most instances the local authorities will not provide real protection. Assuming then that a strike is called on what the War Department's representatives consider unjust grounds and other labor is available, what should be done about such labor or to protect such labor?

A manufacturing plant, or even a government-agent plant, may advertise and solicit labor from other plants at increased rates or other inducements. This may be done openly or secretly. The plant may be in great and immediate need of a certain class of labor and there may be a scarcity of that particular kind of workman. It is not a sufficient answer to reply that some central agency will supply the needs of the plant in question.

Is the War Departments work again to be held by State authorities subject to laws forbidding the export of labor? A centralized employment service is not a successful solution of the recruiting question. The central organization cannot know

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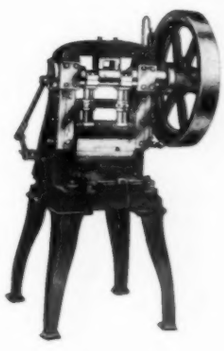

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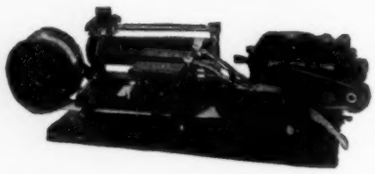

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or care much about any local problem. The local offices of such an agency will not usually exert themselves to export labor from their community. If the War Department branches are under orders to recruit only through such agencies the result involves delay or subterfuge.

Glittering generalities are not very useful, therefore the following definite statements are submitted for consideration.

General Results in the World War: The control of wages, hours and efficiency of labor was not successful. Central control was not successful.

Such control or coöperation as was attempted did not prevent constant strikes and threats of strikes on war work. There was frequent raising of rates, sometimes official and sometimes not, but bearing no relation to the cost of living. A raise of one class or at one location tended to raise all labor on account of the indefinite but assumed relation between class and class. The direct and indirect power given union labor to recruit an enlarged membership and to organize non-union works was not just. Union control of union men did not keep them at one job or obtain a fair day's work. The cost-plus contractor was blamed for the successful efforts of union representatives and the unsuccessful efforts of weak government boards. The official rates issued from a central control raised local rates unnecessarily. The contractor's gain under a cost-plus contract was sometimes less of the purpose behind raises than the opportunity to steal labor from other employment.

Drafting Labor: While the so-called drafting of labor is as logical as drafting enlisted personnel or property, it is not probable on account of political difficulties.

Shifting Labor: It is probable that some shifting of labor will be necessary from district to district. In special cases, such as certain classes of mechanics, this will probably be done in violation of any rule to the contrary. The shifting of labor to the detriment of war work can best be controlled by the recruiting and employing agencies directly concerned with the particular labor in question.

Union Labor: Union labor and its representatives can properly speak for its enrolled membership only. Non-union labor should be represented by non-union men. The union rule against working in mixed crews must be withdrawn for the duration of a war. Unions should not organize any unorganized works, and employers should not attempt to separate from union labor previously employed. It is believed to be a fact that union labor is only a small fraction of the labor engaged in the industries which would produce ordnance matériel.

Labor Rates: It is desirable that labor rates retain their relative relation to the cost of living. An undue increase or decrease renders more difficult the post-war readjustment. It is claimed that the excess wage of capital can be recaptured by taxes, but the excess labor wage cannot be so recaptured.

State Laws: War Department work should not be subject to unreasonably restrictive State laws, such as those prohibiting the export of labor.

Decentralization: It is believed that labor control should be decentralized to the greatest possible extent and that blanket rules and rates should not be issued from a central control.

Control boards should not contain a greater percentage of either union or non-union representatives than the actual M-day proportions of such labor in the local industries under such boards. It is believed that the district should have power to disallow a payroll of unapproved rates of pay. It is believed that local labor boards should be established in each district, with one or more members from the various Army and Navy offices, and representatives of the contractors. Such boards should not contain holders of elective public office. Union representation should be by a local union resident. Non-union labor should be represented by a local employee.

New York, N. Y. R. D. Coombs, Lieut. Col., Ord Res.

AOA

Book Reviews

Taschenbuch der Tanks: 1930 Edition. By Fritz Heigl, Dr. Techn. Munich: J. F. Lehmans Verlag. 1930. 15 Marks.

THE late Doctor Heigl presents in this work a more complete "handbook of tanks" than was his 1926 edition, to which a supplement was issued in 1928. Owing to the rapid changes in mechanized vehicles (the handbook covers not only tanks, but also armored cars, armored trains, and antitank weapons), there is much that is new in this edition.

The compilation of the data contained in this book represents a painstaking labor of inestimable value to all military personnel, both line and staff. The recent untimely death of the author (a major in the Austrian Army during the World War) is a real loss to all concerned with the inevitable development of armored fighting vehicles. Judging by the accuracy of the data given for U. S. vehicles, this book is very authoritative. It is sincerely hoped that the publisher will make arrangements to carry on this important work.

A careful study of the hundreds of vehicles described shows conclusively that American tanks and armored cars are in speed, armor and armament at least the equal of the best produced by other nations. It is particularly noticeable that our tanks have a much higher power-weight ratio than foreign ones, while French vehicles excel in the thickness of armor carried.

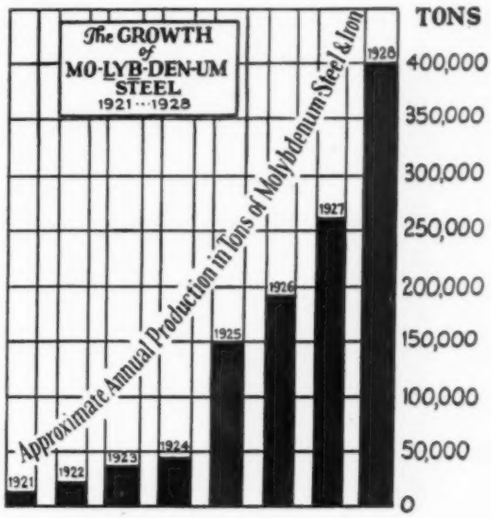
There are three main parts of the book, as follows: I—Discussion of design problems and new engineering developments such as wheel arrangements, tracks, gun mounts, hulls, etc. II—Descriptions of vehicles developed and used by each nation. III—Tactics and the handling of tanks in battle. In the last section, in many respects the most interesting, Heigl says, after questioning the wisdom of wholesale mechanization, "One thing is certain; that we will not send the poor horse on the battlefield any more, at least not in a first class war!"

There are 186 good illustrations, many tables, a tabulated comparison of all the vehicles described, a bibliography and an index. It is an interesting, comprehensive and highly useful military handbook, which shows that "mechanization" is here to stay.

The Martial Spirit. A Study of Our War With Spain. By Walter Millis. Boston and New York: Houghton Mifflin Company. 1931. $4.00.

IF the tale unfolded in these pages were not so tragic it might be likened to a "comic opera war" which was to make of us a new World Power. The embarkation on this adventure led to events which in the beginning were buried in the womb of darkness, but their birth brought a light which was to reveal consequences with which no one reckoned in those days of excitement.

The book is a biography full of conditions which it would be well for every American to understand. The part played by the politicians of the time is not inspiring reading matter and should lead to much thought on the part of the reading public. The state of the times, including the panic of 1893, was such that no doubt the revolution started in the same year in the Hawaiian Islands and two years later in Cuba, with the excitement of a prospective war, to a large extent kept people's minds off their own troubles. The use of propaganda,



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led by one Jose Julian Marti and his cohorts in the United States, fed by tall tales of imaginary horror and blood, played a most important role. In fact it could have given the propagandists of the recent war cards and spades and then beat them in the showdown. Perhaps the churches in the recent strife took their cue from those of 1898, for we find in the mythical horrors denounced from the pulpits of that time the prototypes of those which the same pulpits thundered forth in 1914-1918.

The part taken by the "yellow press" of the day, with the constant repetition of the "tall stories" derived from the fertile imaginations of the untruthful brains of the correspondents, is all given in plain detail. Tales, no matter how untrue, which appealed to the man on the street and made him desirous of putting an end to Spanish tyranny and its torrents of blood are recorded. All was propaganda and politics, and it is incomprehensible how men who were honored by the highest positions in our land could have allowed themselves to be made use of in this manner, except perhaps for their own aggrandizement. The name of none is spared, and all may read and obtain facts which will somewhat reduce the glory which surrounded our heroes with the halo of 1898.

The book is a most complete exposition of our endeavor to be a nation of "saviors," with the consequent ills born through unpreparedness and lack of knowledge as to how a war is to be fought. The advance on Santiago and the destruction of Cervera's fleet, with the accompanying damaged reputations; the adventure in the Philippines, where the "surrendered" Spaniards became our allies in holding back Aguinaldo's troops are graphically described and form intensely interesting reading matter as well as food for thought. All through the book one is constantly convinced that "God takes care of drunken men, sailors and the United States"!

Space is not permitted to say more regarding this book of plain facts, but it is recommended to all who may be interested in reading unbiased history.

This Mechanical World. An Introduction to Popular Physics. By Morton Mott-Smith, Ph.D. (Halle) New York: D. Appleton and Company. 1931. $2.00.

FOR the uninitiated in physics it would hardly be possible to find a clearer exposition of its principles than Dr. Mott-Smith has provided in this little book. The author's aim has been to supply the basic knowledge of our physical environment without any recourse to mathematics. He has been eminently successful. In simple language, and with constant application of concrete examples, he explains the laws of nature, the meaning of density, the multiplication of force, and the other manifestations of physics that are met in every-day life. Within its sphere, the book is an adequate and very satisfactory introduction to an understanding of the many mechanical devices of our civilization.

Conflict. By Rosita Forbes. New York: Frederick A. Stokes Company. 1931. $3.50.

THE author in the course of 7,000 miles of travel from Constantinople through Antolia to Damascus, thence to Palestine, Bagdad, Iraq, Persia, Beluchistan and Hindustan gathered the data for this very interesting scenic and political travel book. A most vivid picture of the antagonisms produced in the attempt to eradicate superstition and the traditions of ages by modernization is presented in a manner to engage even the most casual reader. Here we find not only the antagonisms of the races, but also the older generation against the newer one, accentuated by class against class, and the peoples put to a most severe strain in trying to forget the old and assimilate the new.

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states side-by-side with mandates, and the result is not all that was desired. Lady Forbes vividly describes the Palestine of the Jew and that of the Arab, where only succeeding generations can settle their difficulties, if ever. Persia and its oil fields, with Russia and Great Britain in the background is interestingly described, while Persia's neighbors, Turkey and Afghanistan, look with envy on Persia's sudden wealth.

The holy cities and the religions of the old world are given quite some space, an entire chapter being devoted to the Devil-Worshippers of Kurdistan, a title which sounds much worse than are the facts.

From Kurdistan Lady Forbes again turned towards Constantinople, but approaching it from the East, instead of the West, she says: "I saw it as a gateway to those unsettled lands where civilization is still an imposition and progress synonymous with conflict." Truly a book worthy of a place on any book shelf.

America's Siberian Adventure. By Maj. Gen. William S. Graves. New York: Harrison Smith and Jonathan Cape. 1931. $3.50.

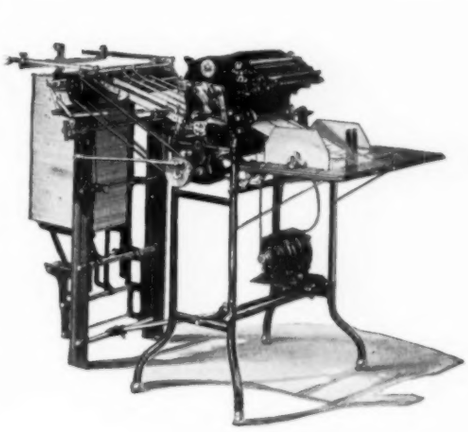
AN extraordinary interest attaches to General Graves' narrative of the American Expeditionary Force which he commanded in Siberia. Through nineteen months of uncertainty his course was beset with unusual difficulties: hostile operations by ostensibly friendly Russian troops; cabals of European high commissioners and delegations anxious to discredit and remove General Graves; open attacks in the American press inspired by Tsarist reactionaries; covert opposition by State Department representatives in Siberia; misrepresentation by welfare agencies assuming to speak for the U. S. Government; complete misunderstanding of the Siberian situation at home; and, throughout the entire period, the sinister threat of open hostility from 70,000 Japanese troops operating with only the merest shadow of control from the Imperial Government in Tokyo.

The portions of General Graves' story which describe his contacts with the Japanese military machine are especially timely in view of the present Japanese operations in Manchuria. Readers will be impressed with the similarity between Japanese methods as reported in the daily press of 1931 and the situations encountered by General Graves from 1918 to 1920. One wonders whether the grandiose plans for an extension of the Japanese Empire on the Asiatic mainland suspended during a decade of recuperation, consolidation and diplomatic negotiation, are now to be resumed.

President Wilson had assigned to General Graves the execution of a difficult policy of neutrality. At the head of a military expedition in the midst of the most merciless civil war of modern times, he must nevertheless refrain from taking sides. The measure of his success was the violence of the denunciations hurled at him by Bolshevik and Tsarist alike.

Under these discouraging circumstances it was fortunate that General Graves did not have to contend with vacillation and weakness in Washington. He received what is sometimes denied to great commanders: the complete confidence and the hearty support of his superiors. Former Secretary of War Newton D. Baker, in his introduction to the book, outlines the difficulties of General Graves' situation and expresses his approval and appreciation of the manner in which the Siberian mission was executed.

Why was an American Expedition sent to Siberia? General Graves does not answer this question, but his book arouses great curiosity as to the real reasons behind this most mysterious of American military undertakings. Will State Department archives reveal in some distant millennium the events which transformed the Texas cowpuncher and the Chicago newsboy into the American patrol on the Amur?



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The American Black Chamber. By Herbert O. Yardley. Indianapolis: Bobbs-Merrill Company. 1931. $3.50.

THIS book relates the graphic story of a young telegraph operator in the State Department who, having been successful in decoding a message from Colonel House to President Wilson, found himself drawn into the vortex of cryptography, and finally into the establishment of the black chamber, or la chambre noire, as the French term it. After his success with the House message, Mr. Yardley convinced the authorities of the weakness of the code employed, and with our entry into the World War he found himself with a captain's commission and an assignment to the Military Intelligence Section of the Army under Colonel Van Deman.

From that moment on things began to move rapidly, and it was not long before he had established a "black chamber" with all its sections and appurtenances. This was not done easily, however, because a proper staff for this sort of work was not readily found, and the pressing need for reforms in our own code and the necessity for deciphering or decoding enemy messages intercepted by wireless presented rather severe conditions to this Army fledgeling.

The chapters on invisible inks are a whole story in themselves, and the repeated failures followed by ultimate success were rather heart-breaking when it was learned the Germans had knowledge of his success almost overnight. This was answered by the Germans with another ink, and the labor had to be performed all over again.

The chapters on decoding and deciphering are very interesting and the intercepted messages which passed between Japan and Great Britain during the Washington Conference throw light on what is happening behind the scenes. These messages came to Mr. Yardley after the war, or after he had established his real "black chamber" in New York. Here he expected to devote his attention to the breaking of diplomatic codes of foreign nations, but he was shocked when, just prior to the London Disarmament Conference, he was informed there was no money available for carrying on his department, and he was reluctantly forced to close down. Yardley states this was because the new Secretary of State deemed the reading of messages from other governments to their representatives as unethical. Whether one believes we should be so altruistic as to refrain from doing so must be left to the individual reader, but the fact remains that this procedure is customary in other countries.

A very interesting book for the general reader, perhaps written in a spirit of pique. It is almost a treatise on decoding which anyone interested will not lay aside without study. This book contains much that borders on the dramatic. In it are some of the elements of military intelligence in time of war which have considerable value even in these piping days of peace.

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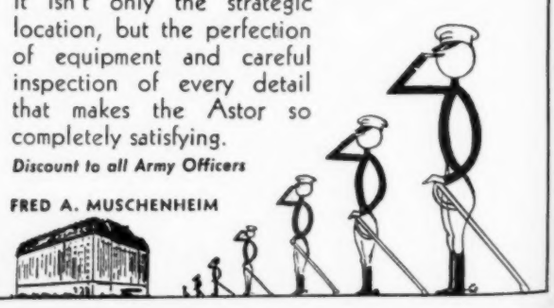
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